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Devitrification and Revitrification of Glass

By J. B. KRAK

(*Written for* THE GLASS INDUSTRY)

Glass is a substance formed at high temperatures, which congeals from a liquid condition as an amorphous, transparent body. Nearly all other substances, on cooling from a molten condition assume a crystalline form and are non-transparent. When liquid glass cools, it gradually becomes more and more viscous, until at ordinary temperatures it is one of the hardest and most brittle substances known to exist. It is impossible to state definitely at what temperature glass becomes solid. The fall in temperature is regular and without a break. Herein it differs fundamentally from most other substances. Glass has many properties which place it in a class of its own. For example, a molten metal, on cooling shows a regular decrease in temperature until solidification begins. From that moment on, until every particle of metal has assumed the solid, crystalline form, the temperature remains the same. This is the melting point, or solidification point of the metal, the two being identical. It is characteristic of most pure substances, and identifies them. After complete solidification the temperature again decreases until it becomes the same as the surrounding air.

Under certain conditions, molten substances may be cooled below the temperature at which they normally become solid, and yet remain in the liquid form. This cooling cannot be continued indefinitely. In the majority of cases solidification sets in. The temperature rises back to the usual melting point, owing to the latent heat of fusion given up by the part that is becoming solid. This temperature is maintained until the transfer to the solid state is finished.

The cooling of glass goes on uninterruptedly and shows no such a break. For this reason glass is considered to be an undercooled liquid, having an extreme viscosity which makes it resemble a real solid. The three different cooling processes may be graphically represented. Fig. 1 shows the cooling curve of a metal; Fig. 2 represents undercooling, and Fig. 3 the cooling curve of glass. A-B represents the cooling to the solidification point; B-C the temperature and time during the process of congealing, and C-D the cooling of the solid substance to ordinary temperature. The part B-C is lacking in the cooling curve of glass. If the fall in temperature is retarded, the time factor, of course, becomes large, and the cooling curve assumes an almost horizontal position. It is then that conditions are created which are favorable to devitrification.

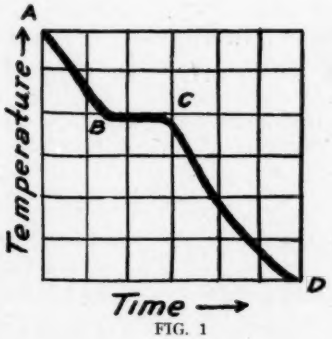


FIG. 1

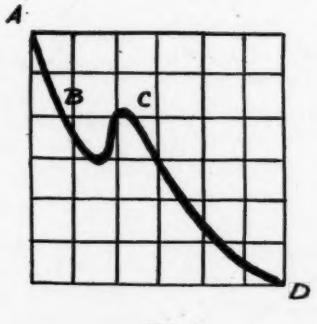


FIG. 2

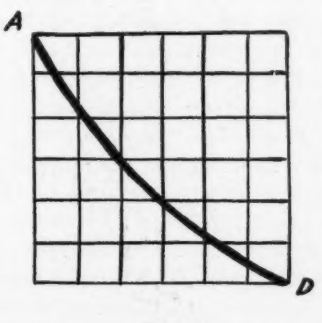


FIG. 3

Physicists find abundant proof for the paradox that glass is a solid liquid. They point to the fact that the latent heat of fusion remains in glass. The substances, given in the

table[1] can be obtained in the crystalline, solid condition and also as glasses, i. e., as solid liquids. Comparison of the temperature of solutions of the two modifications of each substance proves it to be larger in the case of vitreous bodies. Dissolving in hydrofluoric acid liberates the latent heat of fusion remaining in the glass. The crystalline bodies having already given up the heat of fusion, cannot yield as much heat as their vitreous counterparts.

Substance	Heat of Solution in Hydrofluoric Acid in Calories per Gram		
	Vitreous	Crystalline	Difference
Lithium borate	259	203	56
Magnesium borate	719	599	120
Calcium borate	211	161	50
Strontium borate	175	141	34
Sodium silicate	486	457	29
Leucite	533	507	26
Microline	600	517	83

If glass is allowed to cool very slowly, or if it is repeatedly heated to the softening temperature, devitrification may take place. The tendency to crystallize increases with the fall in temperature. However, the viscosity, which opposes crystallization, increases in a much greater ratio with the lowering in heat. Under normal cooling conditions the viscosity rapidly becomes so great that no crystallization can take place. At a high temperature the viscosity is small and while the tendency to crystallize is also small, yet it can proceed, if given enough time. Microscopic examination of fully transparent glass always reveals the presence of minute crystals. These may become centers from which devitrification proceeds, unless checked by viscosity.

An ideal condition for devitrification to fully develop is given when a large tank, filled with molten glass, is allowed to cool of its own accord, as has happened at various times after destruction of glass factories by fire. Under such circumstances it has been found that the upper layer of glass has remained transparent, but is full of a number of white spherulites called "marbles" in the glassworkers' vernacular. Below this layer there usually is a mass of opaque, white glass having a crystalline structure. It is not difficult to remove the marbles from the surrounding glass by careful crushing. They can be split open and reveal a crystalline structure, radiating from the center in all directions. Chemical analyses of marbles and the surrounding clear glass show a nearly identical composition. This evidence is advanced in support of a theory of devitrification, proposed first by Berzelius and defended by Pelouze in 1874 in a paper read before the French Academy of Sciences. These scientists claimed that this phenomenon is simply a change in the physical condition of glass, and that the crystals have no more definite chemical composition than the glass from which they are formed. This view is still held by many, and is supported by numerous analyses and other arguments. Another theory of devitrification was propounded by Dumas[2] in 1830, who considered it to be due to the formation of definite compounds which are infusible at the temperature existing at the moment of crystallization. He maintained that these compounds do not exist as such in the glass but are formed at certain degrees of temperature. Some investigators, while in general agreement with Dumas' views, are of the opinion that glass, in spite of its apparent homogeneity, contains in solution definite chemical compounds which crystallize out, when a point of supersaturation is reached, and viscosity conditions are such as to allow the formation of crystals. They hold the view that glass is a solid solution of crystallizable compounds in a medium which serves as a solvent, not unlike the solution of different salts in water, and that devitrification means the separation of crystals from the mother liquor.

Groger[3] treated devitrified glass first with hydrochloric acid and then with a strong soda solution. He found that the crystalline mass was easily dissolved, leaving behind a vitreous skeleton, which was only slightly soluble. The analysis of the soluble crystalline part is given in the first column of the table below; in the second appears the results of analysis of the vitreous, interstitial residue[4]:

	I Per Cent	II Per Cent
Silica ..... (SiO_2)	52.89	66.97
Alumina ..... (Al_2O_3)	1.12	9.44
Iron oxide ..... (Fe_2O_3)	1.16	1.88
Manganous oxide ..... (Mn O)	0.27	2.60
Lime ..... (Ca O)	39.30	5.83
Magnesia ..... (Mg O)	1.33	0.73
Sodium oxide ..... (Na_2O)	3.57	11.27
Potassium oxide ..... (K_2O)	0.36	0.36

The reason why analyses of crystalline and vitreous glass often show similar results is that both are so intimately mixed that separation by mechanical means becomes impossible. In the preparation of the material for analysis both are crushed and pulverized together. Some analyses published by investigators show considerable differences, in spite of the fact that no attempt was made to separate the crystalline from the vitreous, interstitial material. In the following table of analyses column 1 is devitrified, 2 transparent glass, 3 partly devitrified, and 4 devitrified but partly vitreous glass.[5]

	1	2	3	4
Silica ..... (SiO_2)	55.85	56.84	63.67	62.40
Alumina ..... (Al_2O_3)	2.22	3.64	4.49	7.21
Iron oxide ..... (Fe_2O_3)	1.06	2.59	0.71	2.66
Lime ..... (Ca O)	24.14	21.15	18.65	18.14
Magnesia ..... (Mg O)	7.63	6.37	6.12	4.47
Sodium oxide ..... (Na_2O)	8.47	8.69	5.87	5.12
Potassium oxide .. (K_2O)	0.60	0.40	....	....
Specific gravity ...	2.824	2.724	2.857	2.610

Physically, the crystalline part shows greater hardness and greater conductivity for electricity. According to Dumas, it becomes much harder to melt. This has been denied by several investigators. The experience of the writer has been that a tank full of devitrified window glass could not be restored to the liquid condition after continued heating at the temperature which was maintained under normal conditions. To resume operations it was found necessary to remove the glass from the tank. The devitrified material was crushed to nut size and used as a part of the cullet, without causing any difficulty in melting.

The application of the petrographic microscope to the

[1]Thomson, Thermoch. Untersuchungen, 2, 426.
[2]Dumas, Chimie appliquée aux arts 2, 552.
[3]Chem. Industrie, 1898, 72.
[4]Dingler's polyt. Journal 142, 297.
[5]Dingler's polyt. Journal 148, 58.

problem of devitrification has done much to clear up the controversy which, however, is as yet far from settled. By using the methods of the petrographer it has been possible to measure the angles of the minute crystals, determine their index of refraction and study their optical character with polarized light. This has been the means of identifying them as definite chemical compounds. Silica was found to occur as quartz, tridymite and cristobalite, lime and silica as wollastonite ($CaSiO_3$), alumina, lime and silica as anorthite ($Ca\,Al_2Si\,O_8$) and melilite ($Ca_{12}Al_4\ (Si\,O_4)_2$). These compound substances contain less than 50% silica, while vitreous glass usually runs from 65-75% in silica. In the light of these more recent discoveries, Groger's earlier work appears to be vindicated when he claimed that the crystalline part resembled wollastonite in chemical composition.

Unless more or less opaque glass is desired, devitrification is something which the glassmaker wishes to avoid. At the temperature of fully melted glass there is no danger of devitrification, but it may occur when glass is allowed to cool just before working. From the working temperature down to a few hundred degrees above the normal there is a constant danger that devitrification may start. Other critical periods are during the annealing and during the softening of glass while working it before the glass blowers' lamp. The glassmaker has a practical interest as to how the glassy condition may be rendered permanent through the range of temperature at which he is obliged to operate. The solution of this problem is to be found in the proper composition of the batch and in the avoidance of certain temperatures which are, as it were, incompatible with the composition. Such temperatures should be passed rapidly and the processes of working and annealing should be done at temperatures above the highest crystallization temperature. If this is impracticable, the composition of the batch must be adjusted. It is clear that there also exists a lowest range at which devitrification may yet develop, but it is of no importance to the glassmaker, since at this temperature glass has ceased to be workable.

Excessive silica, especially in glasses low in lime, may cause the formation of a peculiar form of devitrification known as scum. Silica has been identified in scum as tridymite and cristobalite. It appears that the silica has never been completely dissolved, due to lack of heat necessary to melt a high silica glass. An excess of lime or magnesia renders glass liable to crystallization. Pure calcium and magnesium silicate can be cooled to the vitreous state only rapidly, and glass saturated with these compounds is inclined to devitrify. Borax and alumina are used with success to overcome this condition. Glasses containing potash and lead seldom devitrify, and the addition of these substances to the batch may help to eliminate existing troubles. Due to these properties optical glass can be allowed to cool very slowly without crystallization. Soda lime glasses, under similar conditions, would become entirely opaque.

Reaumur was the first to apply devitrification of glass to the manufacture of opaque objects. After him, the substance was named Reaumur's porcelain. He cast objects of high silica glass and allowed them to cool slowly in the furnace. After some time the furnace was reheated and again allowed to cool. This process rendered them perfectly opaque. A number of factories took up the manufacture of articles of this kind, their output being mostly in the form of tiles used for mosaic. The industry has never become very successful.

Modern methods of illumination have caused the development of a great branch of the glass industry, viz., the manufacture of semi-translucent, alabaster and opal glass. According to the degree of opacity desired many different substances are used, such as fluorspar, aluminum fluoride, talcum, aluminum oxide, heavy spar, plaster of Paris, china clay, tin oxide, bone ash, zinc oxide, etc. Recently it has been found that the presence of certain amounts of sulphate, chloride or fluoride are necessary to produce the opaque effect. Whether or not opacity is due to devitrification is an open question. It is claimed by some investigators that it is caused by countless microscopic gas bubbles which reflect the light in all directions, thus giving the impression of dispersion.

Those who are inclined to the view that opacity is due to devitrification point to the fact that glasses of this type sometimes show a tendency to revitrify, under exactly the same conditions which cause transparent glasses to devitrify. It occurs especially when glass of this order becomes overheated. Alabaster glasses have a lower melting point than most alkali-lime glasses and if pots containing the two varieties are heated side by side in the same furnace the temperature may become higher than is desirable to produce alabaster glass. Kryolite glass shows less tendency to revitrify than opal glass made with bone ash, which is easily "burnt out." Revitrification usually starts from the edges and in places where the glass is thin. It is there that the cooling is most rapid and devitrification is prevented by viscosity.

Devitrification and revitrification, then, appear to be reversible, depending on composition, temperature, conditions of supersaturation and rate of cooling. What should be avoided in the manufacture of one variety of glassware is a fundamental requirement for success in another branch. In this, as in many other fields, research may show some remarkable results, the application of which may greatly improve present methods of manufacturing.

Qualifications for Engineering Success

A questionnaire distributed by the Carnegie Foundation for the Advancement of Teaching and which brought in over six thousand replies, gives some very interesting information as to the characteristics which, in the opinion of the engineers to whom the questionnaire was sent, counted for most in a successful career in the engineering profession. The results were as follows:

Character, 24 per cent; judgment, 19.5 per cent; efficiency, 16.5 per cent; understanding of men, 15 per cent; professional knowledge, 15 per cent; technique, 10 per cent.

It is interesting to note that the men who have been most successful in the engineering profession consider qualifications of a general nature, such as character and judgment, even more important than professional knowledge and technique. The result of this questionnaire would indicate that the same characteristics which make for success in business life are essential to success in the professional fields.

Glass Melting in Shallow Pots*

A German Advocate of Melting from the Top Describes Course of Fusion in Shallow, Broad Open Pots

Translated for THE GLASS INDUSTRY

By HARRISON W. CRAVER

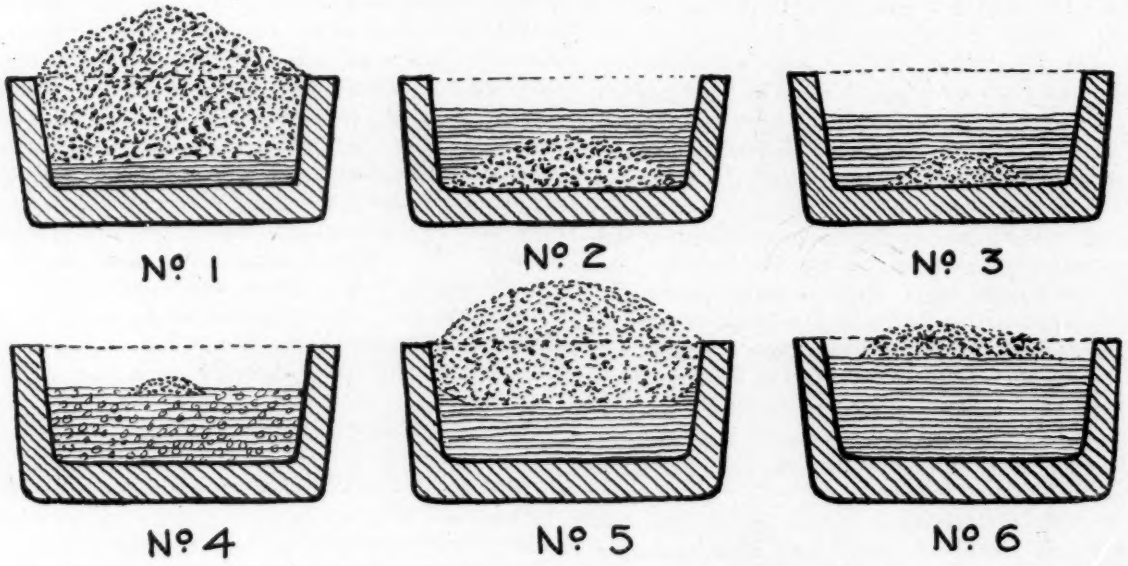
Several letters of inquiry from practical men who can scarcely free themselves from the opinion that "glass can only be melted by good bottom heating," as well as conversational explanations that I have given to the glass interests, which I have supported by word and deed in recent times, appear to lay upon me the duty of instilling a better opinion of the great merits of top heating in a modern glass furnace, into the present large body of doubters by giving here a more complete explanation of it, with a series of pictures. Just at present, when a lack of fuel and raw material is felt everywhere, it seems a favorable time for turning attention in this direction.

To any glass maker who has not yet tried shallow, wide pots I would suggest, as the first piece of good advice, that he observe the melting process as carried out in them by any of his competitors, and learn its advantages. Anyone who is unwilling to take the small amount of trouble to test something new and to choose what is actually best, probably will not be induced to learn anything by the following explanation. However, he probably will regret his indolence and shortsightedness in a few months.

How many unimportant opinions and comments on the course of the melting process have I heard recently! "My melter says this and that." "My workmen claim that bottom heat is lacking." And so it goes, always the opinions of others, with individual opinions only too infrequent.

In factory operation it is entirely self-evident that the owner, manager or superintendent whenever a melter makes bad glass or whenever melting takes an hour or so longer than usual, will question the guilty party and ask the specific cause of the trouble. It is easy to say "there was a lack of heat at the bottom." When the same melter meets the opposite trouble and has overheated several pots, he promptly excuses himself by saying, "the furnace unfortunately is too hot on the bottom." Bottom heating is discussed far and near today, and owners and managers are kept in uncertainty concerning these accidents to a degree that is amusing to an old expert.

My knowledge of the melting process in shallow pots is based on numerous observations of a round four-pot furnace of my own design. In the beginning I would say that this furnace produces the strongest bottom heat of any pot furnace, and that it is usually supposed that the raw batch in the pots is only affected from below. However, this is by no means always the fact. I have at times conducted the melting myself and have followed its course through the various phases, and can only say that the changes in the melting raw batch in any particular pot are seen to occur, day after day, as follows:



When the furnace, after emptying, has been heated again to the proper degree, I commence by charging the new batch, and charge each pot with so much new batch that a large heap is formed, which rises in the middle considerably above the level of the rim. In Fig. 1 the fine horizontal lines at the bottom of the pot represent the residue of glass from the previous melting, since, as is well known, a residue always remains which cannot be cleaned out. During the first hour, or even longer, the batch remains entirely quiet, and it is only after two hours that a gentle movement of the mass becomes apparent. The batch first becomes liquid around the rim of the pot, not from the bottom heat, but from the

*Sprechssal, vol. 53, p. 205, 13 May, 1920.

action of the glowing sides of the pot. A soft ring appears which gradually widens, out of which the mountain of batch rises like an island, until it grows smaller and smaller and finally is submerged in the glowing mass. After three hours from the time of emptying, the mass of unmelted batch still is of considerable size (Fig. 2).

After 3½ hours only a small residue of raw batch is perceptible at the bottom of the pot (Fig. 3); this loosens from the bottom in another half hour, rises to the surface, swims in the pot and melts in a short time (Fig. 4). An increasing formation of bubbles is observed in the pot, similar to that which occurs during the boiling of liquids—the glass boils.

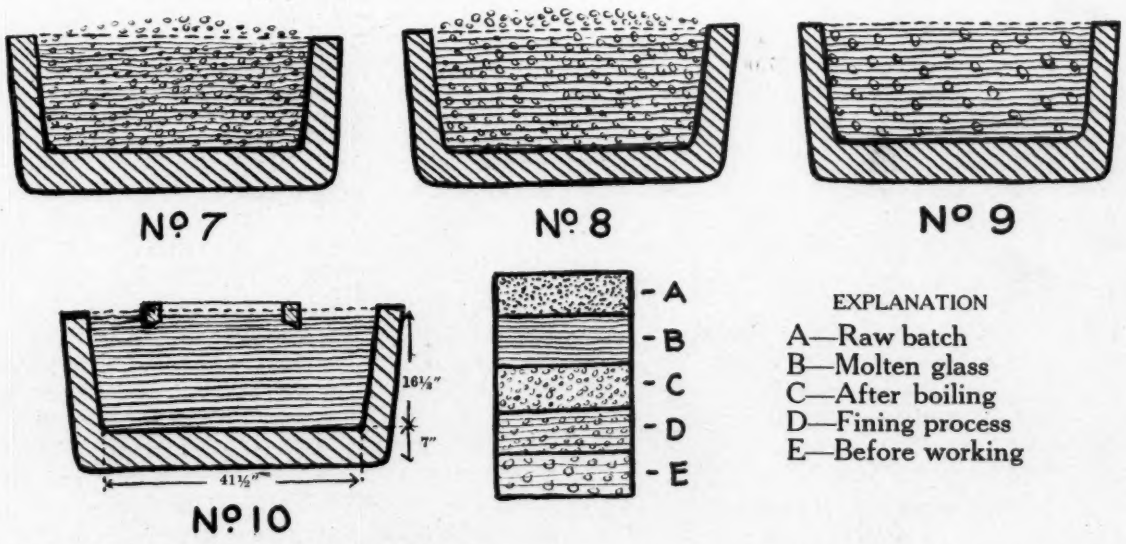
It is now time to add the second lot of the batch, and in doing so the pot again is heaped as in the first charging (Fig. 5). After another three hours, or a total of seven hours of melting, the second charge has changed from the dry, raw condition to the liquid form; it is entirely melted but the pot even now is not filled entirely to the brim. This is the best time to add a few ladles of pure cullet of the same composition as the batch to each pot, because the preparation is exactly known and there need be no fear of modifying or contaminating the chemical composition of the new run (Fig. 6). In another half hour the cullet also is melted and the glass is ready for fining.

For this operation the gas is first reduced, so that there will be more "rest" in the furnace. The melter then takes a suitable bent iron, to one end of which is fastened a piece of wet wood or a beet 8 to 10 cm. long, thrusts it into the glass and pushes the wet appendage back and forth over the bottom of the pot a couple of times. The whole procedure lasts only 20 or 25 seconds for each pot. However, many things must be observed in the manipulation of the "seeding-iron," as there is much misuse of it through ignorance.

During the boiling the liquid mass becomes effervescent (Fig. 7); frequently it threatens to foam over the brim of the pot and the melter has to manage the melt so that no material is wasted unnecessarily. This can be avoided in various ways, either by throwing a little water into each pot, or the stopper and the working holes opened, so that cold air streams over the surface of the glass pot. When the melter is sure that the glass in all the pots has quieted, he can again introduce more gas into the furnace. Fig. 8 shows how the glass clears; that is, less and less bubbles arise and these become larger than before. The boiling takes about 1½ hours.

Fig. 9 brings us to the fining process, which occupies about an hour in shallow pots. When the melter sees that the glass in all the pots is pure and clear, the work holes are opened and the stoppers removed. The gas is shut off entirely and the air and chimney dampers are closed. The furnace is allowed to stand in this condition for about three-quarters of an hour. The few remaining bubbles disappear entirely during this time, since part of them come to the surface and burst, while part of them simply disappear by contracting in the liquid.

When the glass is satisfactorily freed from bubbles, the chimney damper is gradually opened again and gas and air are admitted to the furnace, so that it is reheated in a short time to the temperature necessary for fining the glass. Fig. 10 shows a pot containing perfectly pure molten glass at the time when working can begin. The melting as a whole has taken 11 to 12 hours.



Such a pot contains about 13.4 cubic feet of molten glass.

From the first I have been well aware that there are experts who will not accept my analysis of the melting process as correct in all respects, because they hold the opinion that a shallow pot does not require a special process in any case. Nevertheless, I here recommend that possessors of shallow, broad pots test the procedure that I have given—they will acquire new ideas on the subject which they will not regret. Almost all the melting processes are familiar to me, hence I may be permitted to say a few words about some points.

Some melters, after the completion of a run, first charge a quantity of cullet, which fuses together during the preliminary heating. Pots are easily cracked by this method. It is not advisable to put much cold cullet into a cold pot, especially if it be large, thick pieces.

Other melters use smaller batches and fill the pots only half full at first. These are the obstinate upholders of "bottom heating." When this first batch is barely fused on the surface, a second is weighed out and shaken over it. A third follows this after a certain time, and so on until the pot is heaped full.

According to my observations, this method is not practical, because these new additions of cold batch practically destroy the melting layer found beneath them. This method of charging is distinctly injurious to the quality of the glass. It will be clear to everyone, without further explanation, that a charge of two batches was never sufficient with the obsolete high narrow pot system, because the batch could not be heaped as high in a narrow pot as it can in a broad one. Hence I shorten the melting time considerably with my broad, shallow pots, since I have only two charges of raw batch to melt. Is not this a most elementary numerical example?

Glass melting is an art upon which a large book might be written. An intelligent melter is, therefore, a prime necessity in every factory; but he must not be unprogressive, nor hold too stubbornly to old methods. When changing from deep to shallow pots, it is essential that he be given the necessary explanations and instructions. Only thus can the manufacturer avoid trouble.

Glass Resistant to Sudden Changes of Temperature

By ASHER BLUM*

(*Written for* THE GLASS INDUSTRY)

One of the most interesting of recent developments in the American glass industry has been the production of casseroles, baking dishes and the like from glass which is sufficiently resistant to sudden changes in temperature.

The first American inventor to take up this subject was Van Fleet, whose U. S. Patent No. 607,003 was issued on July 5, 1898. He stated that he desired to produce a glass which could be employed in connection with gas engines and which would be strong and especially free from fracture under sudden and extreme changes of temperature. The inventor also states that this glass would have superior strength and superior electrical insulating qualities, so that it could be heated to any temperature up to fusing and be instantly cooled to zero without fracture.

This glass was made of the following ingredients:

Silica 46.19; iron protoxide 4.70; iron oxide 2.24; magnesia 12.57; water 10; alumina 8; soda and potash not estimated separately, approximately 14.50.

To these ingredients, a flux composed of litharge, borax and sodium bicarbonate was added.

This inventor does not seem to have produced transparent glass, which, of course, would detract from the use of his composition for household purposes. This patent expired on July 5, 1915, so that it is now public property.

The next inventor who took up this subject was Taylor, whose U. S. Patent No. 1,192,474 was issued on July 25. 1916, and assigned to the Corning Glass Works. This glass contains silica, boric acid, lithia and aluminum and has a coefficient of expansion of less than .000005056.

The subject was again taken up by Weintraub, whose U. S. Patent No. 1191630 issued on July 18, 1916, to the General Electric Company.

He described a glass made of silica, magnesium oxide, boric anhydride and sodium oxide, his mixture being such that the glass has an excess of 73 per cent silica.

In British Patent No. 18300 of 1912, the British Thomson & Houston Co. described a glass which they claim has a coefficient of expansion of .0000035 and which would be tough and have a high melting point. This patent describes a borosilicate glass containing 71-72 parts of silica, 3-4 parts of magnesia, 11-12 parts of boric oxide and 12-13 parts of sodium oxide. It can be seen that this patent does not show the use of lithia, which is stated by Taylor to reduce the temperature of fusion of the glass mixture to a very great degree, so as to enable the glass to be worked more economically.

In their British Patent No. 25238 of 1912, Siemens and Schuckert described a glass having low expansion and which could be used as a projector for an arc lamp. This was a borosilicate glass in which the chalk and carbonate of soda were more or less replaced by boracic acid. In their British Patent No. 29577 of 1912, the same concern stated that the capacity of glass for resisting thermal changes was increased by the addition of boron or zinc or both of these substances.

Apparently, the impetus to the large development of glass of this character for culinary vessels was produced by the discovery that lithia when added to the borosilicate glass enabled it to be worked more economically and without lowering its efficiency to resist sudden changes in temperature, and it is interesting to note that this development was entirely American.

*Of Mock & Blum, Patent Attorneys.

Utilizing the Soda Lakes of British Columbia

Reports from British Columbia state that the Sodium Mining and Products Company will erect an evaporation plant at Soda Lake, B. C. Application has been made to the Provincial Government to extend a branch of the Pacific Great Eastern Railway to the lake, which is 3,700 feet above sea level and has an area of 100 acres. The lake is reported to have a sodium carbonate (soda ash) content of 6 per cent. There are a number of smaller lakes in the vicinity containing about the same proportion of sodium carbonate.

Some Fuel Equivalents

1 Gallon Fuel Oil.....	20 Pounds of Coal
5 Gallons Fuel Oil.....	1,000 ft. Coal Gas
8 Gallons Fuel Oil.....	1,000 ft. Natural Gas

Evolution of the Mold Industry

By GEORGE B. ARDUSER*

(*Written for* THE GLASS INDUSTRY)

The last twenty years have witnessed many changes in the mold industry, and the principal reason for this is the development of glass working machines in that period.

Twenty years ago bottle machines were in a more or less crude state and the majority of the bottles were blown by hand. Today bottle machines are used all over the world and the hand blown shops are decreasing in number every day.

In the past the manufacture of molds was much simpler than it is now. They did not require the accuracy they do today, and the iron was always of a standard thickness in the various molds. At present there are many types of machines and each machine has its own particular mold requirements, such as thickness of iron to suit the speed of the machine, special construction to fit the machine, the number of molds and the extra accessories such as plungers, finishes, etc., all of which must be made especially for each type of machine, as they will not, as a rule, fit any other type.

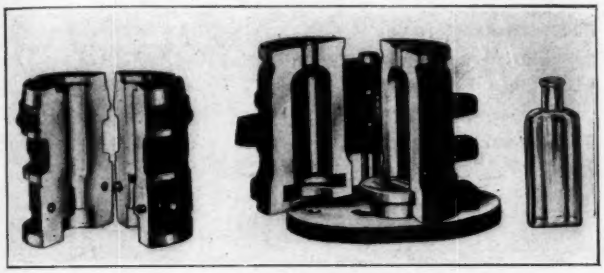


FIG. 1—AN OVAL BOTTLE, BLANK AND BLOW MOLD

We formerly did not know what it was to have a blueprint or a drawing to work from. The journeyman moldmaker was given the sample bottle and was instructed to take his measurements from it and make the mold. As only one or two molds were made for a hand blown shop, this was an easy matter. Now we would work at a great disadvantage without blueprints. A drawing is made for each sample bottle, showing the actual sizes of the blow and blank, the correct thickness of iron to suit the machine the molds are intended for, and every detail is carefully worked out, also taking into consideration the best way of making the mold to insure satisfactory results in the glasshouse. From the blueprint the pattern is made, and after the castings are received each moldmaker performs his operation in accordance with the blueprint. This reduces errors to the minimum, as it is much easier for the workmen to work to an accurate blueprint than to a sample bottle, which frequently is not true in shape. The molds can then be held to a standard size, to one-thousandth of an inch, so that all parts of a set of five to 15 machine molds may be interchangeable, especially the neck rings and plungers.

To insure the required accuracy as well as to supply the increased demand for molds, many valuable labor saving devices and machines have been developed for use in manufacturing molds. Among these devices, perhaps the profiling attachment is one of the most important. This is used on lathes; it saves considerable time and greatly simplifies the work of the lathe hand and each mold is an exact duplicate of the profile, which in turn must check exactly with the blueprint and the sample bottle. There are also special jigs and fixtures used, which are particularly fine for manufacturing finishes and plungers, etc. A very important machine for saving hand labor is the automatic profiling machine for making irregular shaped bottles. This machine will cut from two to four halves at one setting and each one is cut exactly like the master mold. The turret lathe is also of great benefit, especially for production work.

Just as the machines have developed step by step, so has the mold industry progressed. The glass factories are realizing every day more and more that it is very important to have good molds to get satisfactory results with the machines. In other words, it is no longer just a question of making a mold, but of designing and manufacturing it to work in harmony with the machine and also the glass factory in which it is to be used, which in many cases has its individual problems to solve.

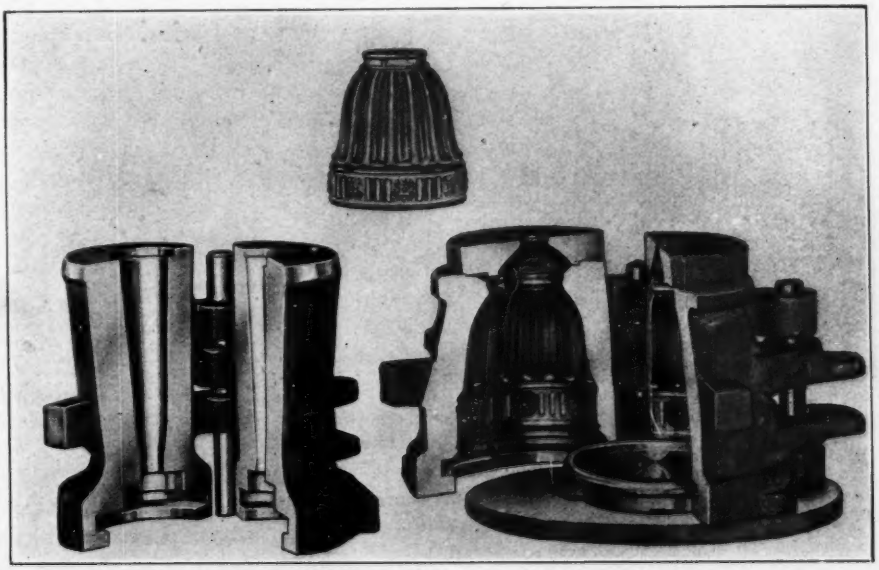


FIG. 2—ELECTRIC SHADE, BLANK AND BLOW MOLD

*Manager, The Toledo Mould Company.

The illustrations show a few molds for different types of ware.

Figure 1 shows an oval bottle, blank and blow mold. These molds were made for a semi-automatic blowing machine. Note the thickness of iron in the blow and blank molds. The blow mold was profiled on an automatic profiling machine. Formerly this was done by hand.

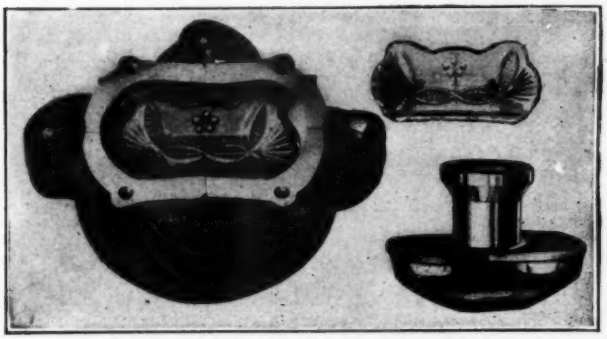


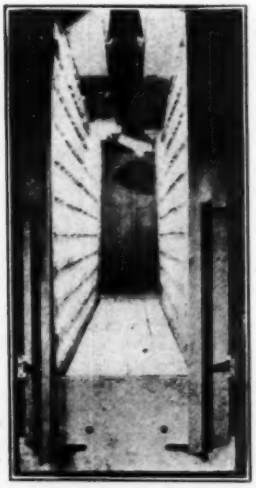
FIG. 3. A MOLD FOR A CUT GLASS BLANK

Figure 2 shows an electric shade, blank and blow mold. These molds were made for a semi-automatic blowing machine. As the shade has a very deep figure the mold had to be made in four parts, making it quite a difficult mold to work on a machine, as the two front quarters have to open so that the shade will deliver from the mold. This shade is made with a bust-off. The blow mold was profiled on a lathe and the figures were cut in with an automatic profiling machine.

Figure 3 shows a mold for a cut glass blank. Great improvements have been made in the manufacture of this class of ware, which make an enormous saving of time and labor in the glass blank factories and cutting shops. Formerly the molds were made plain and only for the more regular shaped articles and the difficult and irregular shapes were made off hand. Then highly skilled cutters were employed to cut the figures in the glass blanks, and this required a great deal of labor. Now the figure is cast in the mold by means of a plaster of paris pattern which is made by pouring the plaster about the sample. When this sets, a deep impression of the figure is left in the plaster cast and is also very plain when cast in the mold. There is just a small amount of machine work to be done on the mold, such as facing and matching it up, turning the dove-tail, bottom plate, ring and plunger. Then the figures are filed and polished smooth by hand so that the glass will not stick.

Electric Heating in Ceramics

By WIRT S. SCOTT*



ELECTRIC ANNEALING FURNACE WITH OVERHEAD CARRIER SYSTEM

The heating elements are concealed back of the baffles, completely lining the side walls and floor. By this means of heating, the heat is generated and distributed uniformly top and bottom.

Industrial electric heating which began with the melting of steel in electric furnaces has proven so successful that its application has spread rapidly. Almost every industry that uses heat is a logical place for electrical heating and the glass industry is therefore affected. In fact, many installations have already been made for the treating of glassware.

A 72 Kw. furnace is used for annealing glassware, at a temperature of 1,200° F. This furnace is 22 inches wide, 10 feet long and 5 feet high, of the overhead conveyor type. In a test several thousand goblets were annealed, the goblets being placed in metal containers consisting of nine trays, each tray holding 25 goblets, five per row and five rows deep.

Sixty-five goblets were selected at random during the test, care being taken to select them from different parts of the furnace, and tested in a spectroscope. Sixty-four showed absolutely no refraction of light rays and were passed as A-1 grade. One goblet had almost imperceptible refraction of light rays and was, therefore, rated in this test as B-1. The physicist making the test stated that compared with their general run of product, this one goblet would ordinarily have been A-1 grade. In their natural gas fired annealing lehrs they have very few strictly A-1 grade, the majority being B-1 grade, but a quantity also of C-1 grade, the lowest possible grade.

All glasses passing through the furnace were bright polish finish. Glasses through the natural gas furnace have a slight blue finish. Manufactured gas presents a deposit greater than natural gas. Fuel oil deposits a decided white powder finish necessitating washing and polishing, and is therefore prohibitive.

FUSING BIFOCAL OPTICAL LENSES

This work must be done at a very critical temperature, besides requiring a uniform temperature to prevent resulting strains, and a clean atmosphere to prevent spoiling the polished faces of the lenses being fused. The lenses are placed on small plaques, four per plaque and each plaque covered with a vitreous enameled steel square cup and fed automatically through the furnace chamber and discharged into a 60 ft. annealing lehr. The furnace chamber of four units is divided into two sections, each 18 inches long. These two sections are maintained at different temperatures.

When the work was carried on originally through gas fired furnaces, the loss was approximately 20 per cent, whereas, electrically treated it is 3 to 4 per cent.

*Manager, Industrial Heating Section, Supply Department, Westinghouse Electric and Manufacturing Company.

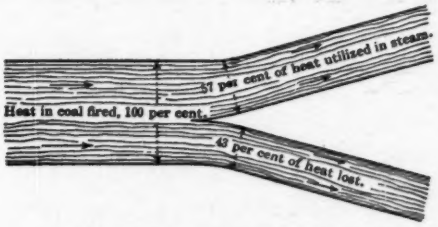
Saving Fuel by Controlling Chimney Losses*

An Interesting Paper Giving Important Information on a Subject Which Is Much Neglected by the Average Manufacturer

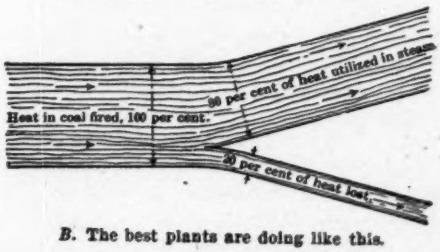
By F. F. UEHLING†

Fuel, of course, has always been the greatest factor in glass making, but until the introduction of modern machinery, glass manufacturers have thought of fuel in terms of heat rather than of power. The following article, written primarily from the standpoint of the power producer, should be of interest to the glass manufacturer of today, who now has a two-fold concern in the economical use of this most important item of his budget.—*Editor.*

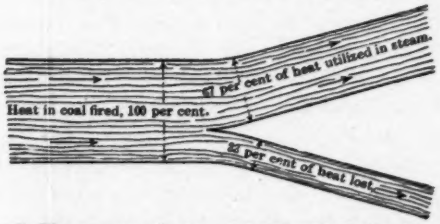
No matter how the fuel we use is consumed and no matter what kind of fuel is burned, whether solid, powdered, liquid or gaseous, the biggest loss is always due to the heat energy wasted up the chimney. In this connection it might



A. **The average boiler plant does like this.**



B. **The best plants are doing like this.**



C. **The average plant can and should do like this.**

FIGURE 1.—Diagrams showing possible improvement in efficiency at average boiler plants.

be well to quote the following very conservative statement from Technical Paper No. 205, issued by the Bureau of Mines:

> In the average boiler plant, 35 per cent of the heat in the coal burned under the boilers is lost with the stack gases. That is, out of every 100 tons of coal burned under the boilers, the heat of 35 tons literally goes up the stack. It is this loss that can be greatly reduced and every effort should be made to do so.

Figures 1 and 2, which are reproduced from the same Government bulletin, illustrate graphically the magnitude of fuel wasted in steam boiler practice and show that the most important part of it is due to the loss up the chimney. According to the writer's experience, however, this loss in the average plant is not less than 40% and in very many cases approaches 50% of the total heat energy in the fuel used.

The loss up the chimney, which is always the largest individual loss in any plant, depends for its magnitude on three factors. They are, in order of importance, first, excess air in the products of combustion; second, temperature of the products of combustion; third, amount of unconsumed fuel in the products of combustion.

GREATEST LOSS DUE TO USING TOO MUCH AIR

The excess air in the products of combustion results in a loss greater than that from any other source. Each kind of fuel requires a definite amount of air to burn it, the exact quantity depending principally upon the ratio of its carbon and hydrogen. When considering coal, for example, the principal constituent is carbon, every pound of which re-

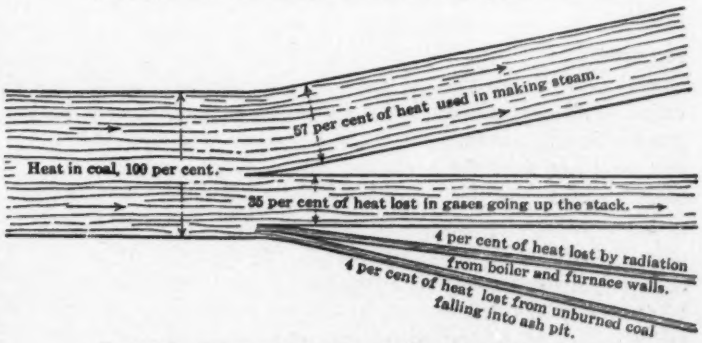

57 per cent of heat used in making steam.
Heat in coal, 100 per cent.
35 per cent of heat lost in gases going up the stack.
4 per cent of heat lost by radiation from boiler and furnace walls.
4 per cent of heat lost from unburned coal falling into ash pit.

FIGURE 2.—Where the heat goes in the average boiler plant.

quires twelve pounds of air to completely consume or oxidize it. All air that is used above this amount is known as excess air, and when supplied in greater quantities than is necessary to meet the particular conditions of the furnace in which the fuel is burned, an unnecessary burden is immediately placed on the temperature possibilities of the furnace and the amount of fuel consumed to accomplish a desired result increases in proportion.

Even in fairly good practice, about twenty-five tons of air is used to burn one ton of coal, and in the more poorly operated plants, this amount is often doubled. Twenty-five tons represents a lot of air. Under normal conditions, it occupies a space nearly 16,000 times as large as the coal which it consumes. If the amount of air generally used to burn one ton of coal were contained in a pipe with one square foot cross sectional area, it would have to be long enough to extend nearly from New York to Baltimore. Stated in another way, if the floor of a room were covered

*Paper delivered before the Fuel Section of the Sixth National Exposition of Chemical Industries, New York, September 21, 1920.

†Combustion Engineer, Uehling Instrument Company.

with coal to a depth of one foot, the ceiling would have to be over three miles high in order for the room to contain as much air as is generally used to burn that quantity of fuel. The fact that so much air is consumed in burning coal is not realized by the fireman and the important relation which this huge mass bears to fuel economy is generally not given sufficient thought by his superiors. Although air costs nothing, and is available in unlimited quantities, when used to burn fuel in excess of what is required, as is the case in the average plant, it becomes one of the most expensive raw materials.

All the air that is used in burning fuel, whether under steam boilers or for any other process, appears in the products of combustion. If three times as much air is used as is necessary there will be just about three times as much products of combustion as necessary. This gas as it passes up the chimney contains the major portion of the heat that is unnecessarily wasted. The exact amount of heat wasted in this way can be determined by the weight of the products of combustion per pound of fuel burned, and the temperature at which they leave the furnace or enter the stack. Thus, in the average plant, from one-third to one-half of the heat contained in the fuel is stolen by the products of combustion and dissipated into the atmosphere.

SMOKE NOT NECESSARILY A SIGN OF WASTE

The other loss up the chimney, namely that due to unconsumed fuel in the products of combustion, is usually not so serious. The old idea that a smoky stack is a sign of tremendous waste is not always true; in fact, whether the gases leaving a chimney are smoky or smokeless is no indication at all as to the efficiency with which the fuel is consumed. Steam boilers, for example, connected with a stack that does not show the slightest trace of smoke may burn twice as much coal per pound of steam generated as when smoke is in great prominence. Black smoke is, of course, unburned carbon, but the amount of carbon in this light and finely divided form that is necessary to give the products of combustion a dark or even a black appearance is generally only a small fraction of one per cent of the actual fuel burned. The additional unconsumed fuel that is apt to be present in the products of combustion is carbon monoxide and hydrocarbons, both of which are caused by an insufficient air supply or the improper mixture of the air with the fuel before it is ignited. Although it is possible for the loss due to this cause to be serious, it is a fact that the average loss from this source can safely be estimated at less than 2%. Figure 3, based on a representative test, gives a good idea of what becomes of the total heat in the coal and particularly how large a proportion of it is dissipated as sensible heat in the products of combustion.

INSTRUMENTS DETECT CHIMNEY LOSSES

It is not the object of this paper to discuss any particular method of burning fuel. To minimize chimney losses, no matter what means is used, we must know whether or not the proper amount of air is being supplied, whether or not air is mixed with the fuel before it is ignited, and whether or not too much heat is left in the products of combustion as they pass up the chimney. Under all conditions these important facts can be determined by consistent flue gas analyses and temperature measurements. In so far as stack losses are concerned, the effect of any change in fuel or method of firing, the results of any additions or changes, or the value of any new appliance, can in this way be determined at once, and the best efficiency under the working conditions of any plant can generally be obtained and maintained without the necessity of lengthy and elaborate tests.

In ninety-nine cases out of a hundred, excessive loss of heat up the chimney is simply due to lack of facilities for determining whether the proper amount of air is supplied. When carbon, the principal constituent of any fuel, is completely burned the result is carbon dioxide (CO_2). Complete combustion occurs when air is supplied in excess of what is needed. When, however, the air supply is reduced too much so that it is little more than that which is theoretically required, there is also a possibility of incomplete combustion due to an insufficient amount of air reaching part of the combustible. When this is the case some of the carbon in the fuel will become only half oxidized, that is, it will burn to carbon monoxide (CO) instead of to CO_2.

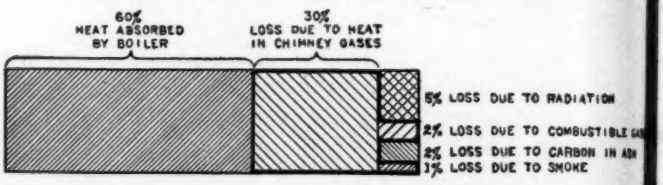


Fig. 3. Chart showing what becomes of the total heat in the coal 60 per cent. is absorbed by the boiler; while almost all of the 40 per cent. waste is due to the heat carried off up the chimney.

CARBON DIOXIDE IN FLUE GASES THE KEY TO WASTEFUL AIR SUPPLY

It must be remembered, however, that the big loss in practice is due to excess air and not to an insufficient supply. In order to clearly illustrate the importance of this fact, let us consider carbon as the fuel we are burning. Since carbon is the principal constituent of all fuels, the same reasoning will also apply to any other fuel, the principal difference being that the maximum obtainable percentage of CO_2 is less when fuels higher in hydrocarbon are used, due to the fact that hydrogen consumes oxygen to form water vapor (H_2O) instead of CO_2. Thus, if one pound of carbon were consumed with the exact amount of air required to completely burn it, the twenty-one per cent of oxygen in the air used would combine with it and appear as twenty-one per cent CO_2 in the products of combustion for the reason that oxygen combines with carbon to form an equal volume of CO_2. On the other hand, if the same weight of carbon were consumed with twice the amount of air theoretically required to burn it, only one-half of the twenty-one per cent of oxygen in the air used would combine with the carbon, the volume of the products of combustion would be twice as much, and the CO_2 content only ten and one-half per cent. Again, if the same weight of carbon were consumed with three times the theoretically required air, only one-third of the twenty-one per cent of oxygen in that air would combine with the

carbon, the volume of the products of combustion would then be three times as great as theoretically necessary and the CO_2 content only seven per cent. It therefore follows that the lower the percentage of CO_2 in the products of combustion the greater will be the volume or weight of the flue gases per pound of fuel burned, and the greater the temperature of this gas as it leaves its zone of usefulness the greater will be the loss per unit of its weight. In average steam boiler practice, for example, every pound of flue gas as it passes up the chimney is laden with sensible heat energy to the extent of from 100 to 200 heat units, and since there are from 25 to 30 or more tons of flue gas for every ton of fuel consumed, the magnitude of this tremendous loss can be readily appreciated. What it amounts to

HEAT CARRIED AWAY BY THE DRY CHIMNEY GASES PER POUND OF COMBUSTIBLE

Pounds of Air Per Pound of Combustible and Corresponding Percents CO_2	Temperature of Chimney Gases, Deg. Fahr.							
	300°	350°	400°	450°	500°	550°	600°	650°
Lbs.								
12	750†	905	1060	1216	1370	1528	1683	1840
21%	5.2‡	6.2	7.3	8.7	9.5	10.5	11.6	12.7
15	865	1112	1305	1498	1679	1880	2072	2262
16.8%	6	7.6	9.1	10.3	11.6	13.0	14.3	15.6
18	1004	1321	1550	1778	2010	2235	2460	2692
14.0%	7.2	9.1	10.7	12.2	13.9	15.4	17	17.9
21	1266	1530	1785	2060	2320	2582	2846	3118
12.0%	8.7	10.5	12.3	14.2	16	17.8	19.5	21
24	1440	1740	2040	2340	2640	2940	3240	3540
10.5%	9.9	12	14	16.1	18.2	20.3	22.4	24.4
27	1611	1950	2281	2620	2958	3291	3628	3962
9.3%	11.1	13.5	15.7	18.1	20.4	22.7	25	27.4
30	1785	2160	2530	2900	3270	3641	4016	4396
8.4%	12.4	14.9	17.4	20	22.6	25	27.8	30.4
33	1957	2362	2779	3180	3589	4000	4405	4820
7.6%	13.5	16.3	19.2	22	24.7	27.6	30.5	33.2
36	2130	2579	3020	3461	3910	4350	4798	5290
7.0%	14.7	17.8	20.8	23.9	27	30	33	36.6
39	2300	2781	3261	3743	4220	4700	5180	5670
6.5%	15.9	19.2	22.5	25.8	29.2	32.4	35.7	39
42	2479	2999	3508	4023	4540	5052	5570	6100
6.0%	17.1	20.6	24.7	27.7	31.3	34.8	39.4	42

†Heat wasted in B. t. u.
‡Heat wasted in per cent of total heat in coal.

FIG. 4.

in actual heat units or in percentage of fuel used depends upon the percentage of CO_2 and the stack temperature. A table based on carbon as the fuel burned is shown in Figure 4. Such a table can be prepared for any kind of fuel. With fuels such as oil, which are high in hydrocarbons, the maximum percentage of CO_2 obtainable would be less, but every one per cent drop in CO_2 would mean a greater increase in fuel wasted than a corresponding drop in CO_2 where a fuel richer in carbon is used. The percentage of CO_2 in the products of combustion is therefore an index to the amount of air used per pound of fuel burned, no matter what commercial fuel is utilized. Chimney losses can thus be controlled, at least to the extent which the particular design of furnace will permit, by the simple regulation of the air supplied, so that the weight of the products of combustion per pound of fuel burned will be reduced to a minimum. The two most important constituents of the products of combustion, for determination by flue gas analyses, are, therefore, the percentage of CO_2 and the percentage of CO. The former should be made continuously by means of a CO_2 recorder, while the latter determination is only necessary when the percentage of CO_2 is so high that an insufficient supply of air to all or part of the fuel is suspected.

Chimney losses, as previously stated, depend upon three factors: the amount of excess air in the products of combustion, which is determined by the percentage of CO_2; the amount of unburned fuel in the products of combustion, the magnitude of which is indicated by the percentage of CO; and the temperature of the products of combustion, which can be determined with an ordinary flue gas thermometer inserted in the last pass of the boiler furnace, just before the gas enters the stack.

Of these three determinations the percentage of CO_2 is by far the most important. The percentage of CO_2 is something the fireman can easily regulate. If the brick setting of a furnace or of a boiler is made tight to prevent air infiltration it is an easy matter for him to decrease the excess air supply to 50 per cent less by simple cut and try methods in the regulation of draft, thickness of firebed, etc., even though the excess air supply may have been 200 or 300 per cent before he attempted to so regulate combustion.

The determination of the percentage of CO, being generally of much less importance, need be made only when there is reason to believe that incomplete combustion exists. In fact the majority of plants where CO_2 recorders are used, get remarkably good results, in so far as economy is concerned, without making CO determinations at all. In other plants, a series of tests is run for determining the maximum safe percentage of CO_2 without the formation of CO and the firemen are instructed to keep the CO_2 as near this point as possible without exceeding it. In many plants, however, the practice of merely instructing the firemen to keep the percentage of CO_2 as high as they can has led to surprisingly good results.

LOW TEMPERATURE AND SMALL VOLUME OF CHIMNEY GASES DESIRABLE

The third variable, namely the temperature of the products of combustion as they enter the stack, is one over which the firemen have no control at all. This temperature should, of course, be kept as low as possible, but it depends entirely upon how much of the heat in the furnace is absorbed or utilized before the products of combustion make their final exit. In boiler practice, for example, stack temperature depends upon the area of the heating surface over which the hot gases pass and the cleanliness of the heating surfaces. The lower the stack temperature, the less will be the heat wasted; on the other hand the higher the percentage of CO_2 the less will be the volume of flue gas to carry away valuable heat energy as it passes up the chimney. Since the temperature of the products of combustion does not vary materially during short intervals of time, the percentage of CO_2 by itself becomes a most reliable index to the greatest loss of all—the sensible heat energy wasted up the chimney.

Computing Heating Values

For estimating purposes in computing heating values, the following average figures should be used:

Producer Gas	150 B.T.U. per cu. ft.
Coal Gas	600 B.T.U. per cu. ft.
Coke Oven Gas	550 B.T.U. per cu. ft.
Natural Gas	1,100 B.T.U. per cu. ft.
Fuel Oil	125,000 B.T.U. per cu. ft.

Certain Surface Effects in Glass

Probably Produced by Reheating in the Glory Hole

A Paper Read at the London Meeting of the Society of Glass Technology, May 19, 1920*

By DR. MORRIS W. TRAVERS, F. R. S.

A few weeks ago, Dr. R. Whytlaw Gray, while showing me some experiments on the deposition of fog particles on glass surfaces in the laboratory of Eton College, directed my attention to a curious phenomenon. A powerful beam of light was projected on to a microscopic slide, and the particles were examined by reflected light by means of a high-power microscope. The first surface of the glass was in focus, and it was noticed that while some slides were scratched on the surface, others appeared to be minutely pitted.

We examined a number of slides and pieces of photographic glass plate together, and found that in every case the pitting appeared on one side of the plate and the scratches on the other. The result of photographing the images is shown in the figure, *A* representing the pitted surface, *B* the scratched surface.

Further careful examination showed that the apparent pitting was due to the formation of a minute seed consisting of bubbles, measuring about 1μ, immediately below the surface. As a provisional explanation I suggested that it was due to the evolution of gas from the outer surface glass in the process of reheating the ball before blowing the cylinder. The scratches on the reverse side, the inside of the cylinder, would then be due to the action of the wood block used in the flattening process.

To check this idea, we picked out from the laboratory glassware pieces in which the glass would certainly have been reheated in the glory hole in the process of manufacture. Such articles as clock-glasses, which are cut from large globes, always showed this pitted appearance, on the *outer* surface only. The pitting did not, of course, appear in plate glass.

All glass which is colorless and which contains manganese must probably also contain oxygen in solution, the oxide or silicate of iron and manganese being in equilibrium with this oxygen,

$$2MnO_2n(SiO_2) = 2MnOn(SiO_2) + O_2,$$
$$2Fe_2O_3n(SiO_2) = 4FeOn(SiO_2) + O_2,$$

the reactions proceeding from left to right as the gas is evolved from the glass. If the glass in the pot is "plain" and of "flint" color, and the temperature suddenly rises, the equilibrium is disturbed in the same direction, and the effect called "after boil" is produced. When the glass is worked in the air-gas lamp flame the glass does not become hot, or mobile enough, to produce any effect, and if bubbles are formed it is only because the glass is already seedy. In the oxy-hydrogen flame even plain glass will show a "boil."

In a direct-fired glory hole intense radiations are given off from the burning coal or coke, and to these radiations glass is opaque. Reheating in a direct-fired glory hole may therefore result in intense heating of the surface of the glass, which would account for the phenomenon observed * * *.

DISCUSSION

Mr. R. L. Frink said Dr. Travers had, in his opinion,

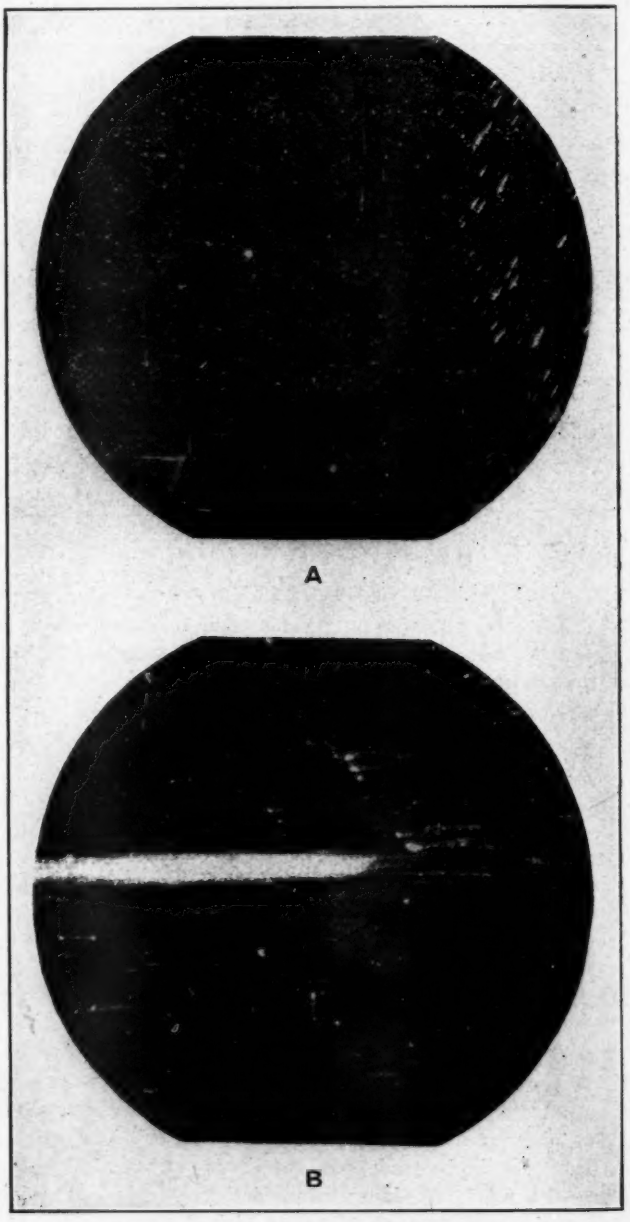


FIG. A REPRESENTS THE PITTED SURFACE OF ONE SIDE OF A PIECE OF GLASS
FIG. B REPRESENTS THE SCRATCHED SURFACE ON THE OTHER SIDE OF THE SAME PIECE OF GLASS

*Journal of the Society of Glass Technology, Vol. IV, No. 15, October, 1920, pp. 284-286.

not stated an hypothesis, but a fact; for in a series of investigations made on photographic dry-plate glass concerning the relative value of different methods of manufacturing them, the conclusions reached were as follows:

That when the glass was made by the ordinary hand method and was blocked by wood blocks which were kept fairly moist, there was a reduced amount of the specking or tiny seeds appearing on the outside of the ball, even upon reheating. Without question, the seeds referred to and the blemishes shown in the photomicrographs were those produced by dust taken up from the block of the ball. However, in many photographic plates there would be found to exist minute specks or particles, these usually occurring because of dust existing on the flattening stone or logger, and which became embedded in or adhered to the surface of the glass.

The scratches arose during the flattening, Dr. Travers had stated. This was proved by the fact that where photographic plate was made by the machine process, one seldom, if ever, found the minute seeds on the outside surface, but any blemishes on the outside of the cylinder were of a specky character and the inside was scratched by the flattening block. To prove this, flattened portions had been produced by making the cylinders sufficiently large to be capable of being split through their diameter, and then flattening them in the inverted position, thereby bringing the interior of the cylinder into contact with the flattening stone and the exterior into contact with the flattening block. The result was the production of scratches on the exterior of the cylinder and the specks on the interior. Further than this, he had seen photographic plate, as well as microscope slides, made by the sheet-drawn process when no flattening was required, and on this occasion neither blisters, specks, nor scratches were found.

Dr. Travers (*communicated*): He could not accept Mr. Frink's hypothesis as an explanation of the facts * * *. That the seeds appeared on the outer surface of the sheet glass and of the clock glass precluded the possibility that they were due to dust taken up in the flattening process. * * *

The Laboratory

By J. B. KRAK

Technical Analysis of Soda Ash

Practically all the soda ash used in the glass industry at the present time is made by the Solvay process. The reactions involved in this process were discovered about 1838 but owing to mechanical difficulties its practical success was not established until 1867. In this year Ernest Solvay received a bronze medal for his product at the Universal Exposition at Paris, and his company paid a first dividend to its stockholders. The first Solvay soda was made in the United States in 1884 at Syracuse, N. Y.

The ammonia soda process depends on the fact that sodium bicarbonate is only slightly soluble in a cold ammoniacal solution of common salt. Strong brine is purified from silica, iron, magnesia, etc., and saturated, first with ammonia gas and then with carbon dioxide gas. The reaction is as follows:

$$\underset{\text{Salt}}{NaCl} + \underset{\text{Ammonia}}{NH_3} + \underset{\text{Carbon dioxide}}{CO_2} + \underset{\text{Water}}{H_2O} = \underset{\text{Sodium bicarbonate}}{NaHCO_3} + \underset{\text{Ammonium chloride}}{NH_4Cl}$$

The ammonium chloride remains in solution, the sodium bicarbonate is precipitated. The milky liquid is run into centrifugal machines and separated from the mother liquid, washed with water and calcined. The following is the reaction:

$$\underset{\text{Sodium bicarbonate}}{2\ NaHCO_3} = \underset{\text{Soda ash}}{Na_2CO_3} + \underset{\text{Carbon dicxide}}{CO_2} + \underset{\text{Water}}{H_2O}$$

The soda ash is exceedingly pure and contains usually over 98 per cent Na_2CO_3. It must be very low in iron to be used in glass manufacturing.

Soda ash, on exposure to air takes up moisture and carbon dioxide, reverting to sodium bicarbonate. Such exposed ash must be dried for two hours at 200° Centigrade before analysis. Fresh soda ash can be analyzed without previous drying and it is not necessary to make the bicarbonate determination on such ash.

ESTIMATION OF SODIUM CARBONATE.—Weigh 2.65 grams of the sample and dissolve in distilled water. Add about 45 cubic centimeters of N/1 sulphuric acid and boil off the liberated carbon dioxide. Allow to cool, add a few drops of methyl orange indicator and titrate to the exact end-point, under constant stirring.

1 cc. N/1 H_2SO_4 = 2 per cent Na_2CO_3

1 cc. N/1 H_2SO_4 = 1.17 per cent Na_2O (total alkali)

ESTIMATION OF SODIUM CHLORIDE.—Weigh 2.65 grams as above and add exactly the same number of cubic centimeters of N/1 sulphuric acid as were needed to neutralize the soda. Add a few drops of potassium chromate solution and titrate with N/20 silver nitrate solution until the yellow color changes to a reddish tint. Deduct a blank of 0.2 cubic centimeters.

1 cc. N/20 $AgNO_3$ = .11 per cent NaCl

ESTIMATION OF IRON.—Weigh a 50 gram sample, dissolve in about 350 cubic centimeters of water and add sulphuric acid in slight excess. Place a strip of pure aluminum metal in the solution, heat to boiling and allow it to remain until the iron is reduced. Remove the strip, wash it with water and titrate the solution with N/20 potassium permanganate.

1 cc. N/20 $KMnO_4$ = .0056 per cent Fe

1 cc. N/20 $KMnO_4$ = .0080 per cent Fe_2O_3

ESTIMATION OF SODIUM BICARBONATE.—Dissolve a 5 gram sample in about 50 cubic centimeters of water and titrate with N/1 sodium hydroxide solution. The end-point is reached when a drop of the solution, added to a drop of silver nitrate on a test plate instantly gives a dark color.

1 cc. N/1 NaOH = 1.68 per cent $NaHCO_3$

A test plate may be conveniently made by dipping a sheet of white paper in pure, molten paraffin. The drops on this surface assume a spherical form, which renders the detection of the end-point more delicate.

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CONTENTS

	Page
Devitrification and Revitrification of Glass	29
Glass Melting in Shallow Pots	32
Glass Resistant to Sudden Changes of Temperature	34
Utilizing the Soda Lakes of British Columbia	34
Evolution of the Mold Industry	35
Electric Heating in Ceramics	36
Saving Fuel by Controlling Chimney Losses	37
Certain Surface Effects in Glass	40
The Laboratory:	
Technical Analysis of Soda Ash	41
Editorial:	
Revise Your Insurance Policies	42
A, E or H?	42
Technical Consultation Service	43
Correspondence and Discussion:	
The Hess Burner	43
From a Cullet Wheeler's Notebook	44
Properties and Uses of Gypsum	44
Foreign Patents in Jeopardy	44
Patents	45
Glass Factory Equipment and Supplies:	
The Chief Ingredient of Glass	47
The Tirrill Gas Machine	47
Objections to Proposed Haugen Bill	48
American Ceramic Society—Annual Meeting	49
Trade Conditions in Europe	50
Trade News	51
Monthly Summary of Foreign Commerce of the United States	54
Current Prices of Glass-Making Materials	54
Stock Quotations	54

NEW YORK, FEBRUARY, 1921

Revise Your Insurance Policies

Inquiries made in a number of directions disclose the fact that a considerable number of owners of glass factories do not realize that old fire insurance policies, based on before-the-war values, are not giving them adequate protection. Replacement costs of buildings, machinery and other equipment undoubtedly run at least 100% higher in these days than five years ago.

The increasing use of expensive machinery and apparatus which must be properly housed to prevent deterioration, is having its effect on the character of glass factory buildings. Ramshackle sheds, built to last only as long as the supply of natural gas was expected to hold out, are gradually disappearing in favor of modern structures more in keeping with the marvelous glass-making inventions they shelter. Many of the old time glasshouses were uninsurable, but the owner of a modern plant can secure protection, and it would be well for the management of every factory, which has not already done so, to give some thought to this matter and take such precautionary measures as common sense dictates; bearing in mind, while doing so, the fact that the co-insurance clause of fire insurance policies makes it unsafe to carry less than full insurance.

A, E or H?

Ought we to spell it leer, lear or lehr? Or shall we dodge the issue and call the thing an oven? An interesting discussion has been started by one of our readers concerning the correct spelling of this seemingly innocuous, but potentially vexatious little word, which persistently refuses to confine itself to a single conventional form and bobs up serenely here, there and everywhere, in almost as many guises as there are letters in its make-up. None of the three forms cited above lacks defenders. In the everyday affairs of the trade throughout the United States, among the glass manufacturers themselves, *lehr* seems to be most commonly used, and partly for that reason was adopted by THE GLASS INDUSTRY. But the dictionaries side with the champions of *leer*, and the Patent Office employs that form, as do also many well-known American writers. The *Journal of the Society of Glass Technology* spells the word *lehr* and British glass journals and trade usage follow the same practice with occasional exceptions in favor of *lear*.

The situation is neatly summed up by Dr. E. Ward Tillotson, who writes:

"I am glad to know that someone else is also worrying about the right way to spell *leer*. The dictionaries, as you know, give equal preference to *leer* and *lear*. *Lehr* is not given in any dictionary so far as I know. Some English writers (Rosenhain, for example) use *lear* while others use *lehr*. *Lehr* is, of course, the German spelling, and that, I think, accounts for its common use among workmen and in the trade. I, myself, have adopted *leer*, although I could be persuaded to use *lear*, but I do not think that *lehr* is justified as an English word."

The preponderant evidence seems to favor *leer*, but in the absence of an official pronouncement by the American Ceramic Society, or any other representative body, we should like to have the opinions of our readers on this subject.

Owing to the pressure upon his time of other duties, Wilbur F. Brown, who contributed valuable technical papers and editorial work in connection with the "technical consultation service department" in our early issues, finds it necessary to discontinue the work, and this department hereafter will be supervised by J. B. Krak, formerly chief chemist of the United States Window Glass Company.

Correction

In the article on Technical Analysis of Sand, in our January number, a typographical error in the seventh line of the second paragraph from the top of page 14, caused the word "sodium" to appear instead of solution. The text, corrected, reads—"and after twenty minutes titrate the iodine with standard sodium thiosulphate solution, using starch solution as indicator."

Technical Consultation Service

THE GLASS INDUSTRY invites its readers to refer to this department any problems with which they may be confronted pertaining to raw materials, glass technology, laboratory and factory practice. While making no pretensions to the possession of unbounded knowledge or infallibility THE GLASS INDUSTRY is ready to assist its readers to the best of its ability in solving their problems. Readers who can offer better suggestions are invited to sumbit them.
Answers to all questions will be made by mail as promptly as possible. The source of all inquiries will be held in strict confidence.

QUESTION 3.—Will lepidolite prevent the formation of scum on the surface of the molten glass? We operate a continuous tank and produce machine blown window glass.

ANSWER.—Lepidolite, or lithia mica, contains from 40-45% silica, 19-38% alumina, 0-5% manganese, 0-0.5% magnesia, 4-11% potassium oxide, 0-2% sodium oxide, 1-10% fluorine, 1-6% lithium, 1-3% water. In some varieties calcium, iron, phosphoric acid and chlorine may occur. This mineral is found in considerable quantities near Pala, San Diego County, California; also at Paris and Hebron, Maine, and Chesterfield, Mass. It is a source of lithium salts.

Lepidolite, used in sufficient quantity, would undoubtedly lower the melting point of the glass and make it easier to work, both on account of its contents of lithium and of alumina. For the manufacture of special glasses in pots and on a small scale, the substance may have its uses, but we fail to see how it could be of benefit in the manufacture of window glass. Every trouble occurring in this branch of glass manufacturing can be traced back to faulty composition of the batch or to some furnace condition. Scum may be due to lack of heat or to an excess of silica, combined with a lack of lime, and it seems very doubtful if the addition of a small amount of lepidolite would be of any use. Good window glass can be made without it, and in our opinion the application of lepidolite in this case is not unlike the use of a patent medicine. And its result likewise, purely psychological.—K.

Correspondence and Discussion

While cordially inviting readers' criticisms, and discussions and expressions of opinion on matters affecting the trade, THE GLASS INDUSTRY assumes no responsibility for statements made in communications printed under this head.

The Hess Burner

To the Editor of THE GLASS INDUSTRY:

In your January issue of THE GLASS INDUSTRY there appears an article on page 24 entitled "The Hess Burner," about which there is surely something wrong, which for the benefit of the trade should be corrected.

Mr. Hess states they are using as low as 22 tons of coal in 24 hours, and are filling in 1800 lbs. of batch and 1800 lbs. of cullet every hour out of 24, but he states further that they are now burning approximately 500,000 ft. of producer gas per day while they formerly used between 750,000 and 800,000 ft. of natural gas. However, Mr. Hess knows that 22 tons of coal produces 2,860,000 ft. of producer gas, which is the amount used as stated, and not 500,000 ft.

The heat value of 500,000 ft. of producer gas is 75,000,000 B.T.U., and the value of 2,860,000 ft. or 22 tons of coal is 1,429,000,000 B.T.U., and the heat value of 750,000 ft. of natural gas is 750,000,000 B.T.U., so it is clear then, according to Mr. Hess' claim that his burner is doing with 75,000,000 B.T.U. what formerly required 750,000,000 B.T.U., or a saving of 90 per cent.

We feel that the article should be subject to correction, so no one can take for fact what may have been stated in error.

THE MANUFACTURERS EQUIPMENT COMPANY,
By J. L. SCHROLL, *President.*

Dayton, O., Jan. 25, 1921.

To the Editor of THE GLASS INDUSTRY:

I appreciate very much your favor of January 27th, calling attention to error I made. I did not express myself clearly when I said:

"They are now burning approximately 500,000 ft. of producer gas per day while they formerly used between 750,000 and 800,000 ft. of natural gas."

What I had in mind when I wrote was this:

"They are now burning producer gas equal to approximately 500,000 ft. of natural gas per day which they used on their tank, while they formerly used between 750,000 and 800,000 ft. of natural gas" in their plant, etc., not alone on their tank.

They were using between 24 and 25 tons of coal a day at the time I wrote you, and as I understand a ton of coal is equal to a little better than 20,000 ft. of natural gas, you will understand I had natural gas in mind when I wrote producer gas, because 25 times 20,000 equals 500,000 ft. of natural gas, not producer gas. Furthermore, the producer gas was only used on their tank through the preheating burner, while they used natural gas for their blow furnaces, flattening ovens and bending works.

While the exception the gentleman took to my statement was well taken because it appeared in print, still it is immaterial whether or not 22 tons of coal will gasify 500,000 ft. or 5,000,000 ft. of producer gas, because it is merely a problem in arithmetic, and does not add to nor detract from the fact that they at times used only 22 tons of coal in 24 hours, and furthermore, does not detract from the efficiency of the burner.

I very much regret the occurrence of the error, which I noticed after I received your January number, but as I thought it would only make matters worse, I did not write you, because as above stated, it was merely a matter of calculation, and wouldn't deceive anyone except myself.

Clarksburg, W. Va., Jan. 29, 1921. JOHN G. HESS, JR.

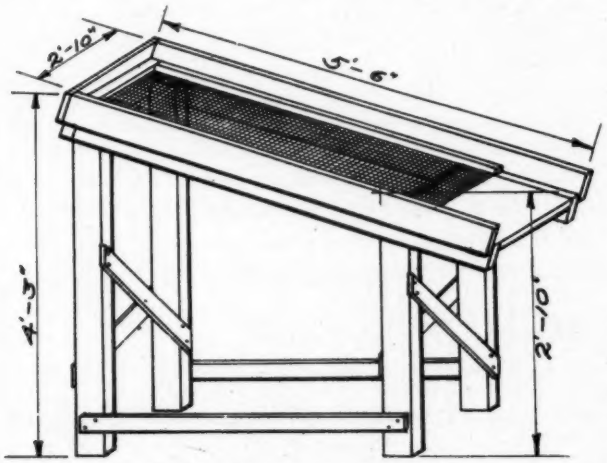
From a Cullet Wheeler's Note Book

By DICK LEE

A Cullet Cleaning Screen

Did you ever try cleaning cullet, yourself?

I did. I began working in a glass factory as a laborer. At the end of the first week the work was cleaned up 'round the factory, so we were put to cleaning cullet. Each man was given a barrel with both heads out, and a small round sieve that would rest on the end of the barrel. We were then instructed to place one shovelful of cullet in the sieve, and with a circular motion shake the sieve like the dickens.



A HOME-MADE CULLET SCREEN

This would coax the fine dirt and also the finer glass into the barrel and part of it into the tops of our shoes. Then we would pick out the small pieces of bricks, stones, etc. The cleaned cullet was placed in a waiting wheelbarrow. This operation was repeated until our shoes were filled with fine glass and the wheelbarrow filled with clean cullet. The load was wheeled to the doghouse platform.

One day, I'll never forget it, it was suggested to build a cullet cleaning screen, like this drawing. That afternoon two of us tried her out. Oh! what a funny feeling. "No more fine glass in our shoes." One man worked on each side of the screen and these two men were able to clean more glass than six men by the "shake like the dickens" method.

Three or four shovelfuls of glass were placed as near the top of the screen as possible. With small sticks the men worked through the lower side of the pile and gradually into the heavier part of the pile. By this method the cullet was worked down the screen. When it reached the bottom of the screen the small pieces of brick, stones, etc., were picked out and the cullet was scraped into the wheelbarrow, under the lower end of the screen.

Properties and Uses of Gypsum

Gypsum is a soft white rock, usually occurring in beds. Other varieties of the same material are known as gypsite and alabaster. It is of common occurrence throughout the United States. Chemically it is a calcium sulphate combined with water. Anhydrite is a variety which contains no water.

Raw gypsum is used for the manufacture of Portland cement and as a fertilizer.

Calcined gypsum is made by heating raw gypsum in a kettle until the first evolution of water has ceased. It contains one-fourth as much water as the raw material. This product is frequently known as plaster of Paris and is used either as such or as the basic ingredient for the manufacture of wall plaster, potters' plaster, dental plaster, etc. Iarge quantities of it are used in the manufacture of Portland cement, plate glass and cold-water paints.

When calcined gypsum is mixed with water, it sets to form a hard mass. The time required for this reaction can be varied at will by the addition of suitable retarders or accelerators.

Recommended specifications for calcined gypsum, neat gypsum plaster, gypsum plaster board and gypsum wall board are given in full in Circular No. 108, Bureau of Standards, Department of Commerce, Washington, D. C.

Foreign Patents in Jeopardy

As the result of a hearing before the patent committee in Congress held on Tuesday, January 11, 1921, the Nolan Bill (H. R. 15662) has been introduced into Congress for the purpose of putting right many applications for patents filed abroad on behalf of United States citizens. This bill will probably entitle United States citizens to claim the benefits of the extension of the Berne International Convention under the special Treaty of June 30, 1920. This Treaty provides for the filing up to March 31, 1921, of patent applications which are the subject matter of patent applications filed in other convention countries on or after August 1, 1913, and the last day for restoring patents forfeited by reason of the war in foreign countries is September 30, 1921.

Many applications for patents have been filed abroad under the Treaty of Peace or war legislation, which if granted will be of very doubtful validity, and moreover many back taxes have been paid to restore patents owned by United States citizens, and the restoration of which will be refused, or if granted, open to question unless war legislation of the character of H. R. 15662 is enacted in this country.

It was intimated at the above hearing that unless the present bill goes through during the short session of Congress, it will probably be a year before the matter can come up in the House for action.

Manufacturers and patentees are urged to immediately communicate with their senators and congressmen, and to have their trade associations pass resolutions in support of the bill, and to transmit copies of these to the chairman of the patents committees in Congress urging immediate action for the bill.

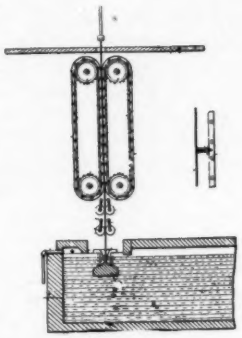
For the convenience of those interested, copies of the Nolan Bill and translation of the text of the Treaty arrangement of June 30, 1920, extending the time for filing applications under the provisions of the International Convention may be had from Marks & Clerk, international patent lawyers, 220 Broadway, New York.

Patents

RECENT INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Glass-Drawing Process. U. S. 1,364,895. January 11, 1921. Harry G. Slingluff, of Mount Vernon, Ohio, assignor to Pittsburgh Plate Glass Company, of Pittsburgh, Pennsylvania.

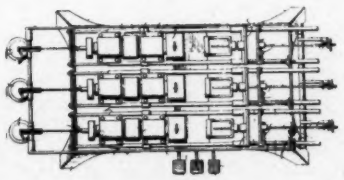
The invention relates to a process for drawing glass in sheet form. It has for its primary objects the provision of an improved process as follows:



(1) the thickness and position of the side edges are maintained and a sheet of substantially uniform width produced; (2) the line of generation of the sheet is prevented from moving back and forth in the bath of glass from which it is drawn; (3) a sheet substantially free from the lines characteristic of sheet glass as hereto drawn from a slot or from too close contact with a forming body or from glass which is too cool, is secured; (4) glass of single strength thickness or even less may be drawn; (5) the glass sheet drawn may be straightened both horizontally and vertically without marring, before annealing and during the drawing operation; (6) the glass may be annealed as it is drawn without reheating it; (7) and in general a perfectly flat annealed sheet of glass of substantially uniform thickness from edge to edge may be made in a continuous unitary operation. One form of apparatus and means for practising the invention are illustrated in the accompanying drawing.

Machine for Grinding Glassware. U. S. 1,364,940. January 11, 1921. Albert Breakenridge Knight, of Fairmont, West Virginia.

As shown in the illustration, this invention relates to a machine for grinding the cracked off ends of glassware, such as drinking glasses, but is not necessarily restricted to this use.



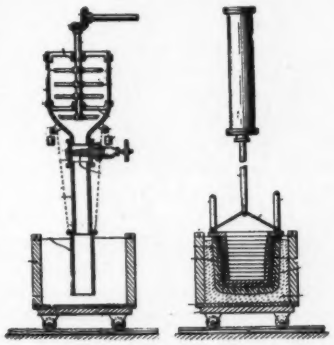
An important object of the invention is to provide a machine of this type, adapted for simultaneously grinding a number of glasses. In the present machine, the inventor has provided means whereby even operation of the different spindles may be obtained. The treadles by means of which the chucks carrying the glassware being ground are shifted to and from the grinding element, require different pressures in order to cause the chucks to perform the same shifting movement. Very often, one of the grinding units of the machine would remain idle because the operator found difficulty in operating that particular chuck, from the extra weight necessary to operate the treadle. The action of the treadle of each of the units is even; in other words, the same weight applied to the same distance to each of the treadles will give the same result in shifting the chucks of the units.

A further object is to provide a belt drive for machines of this character, which will permit the various units to be arranged in a straight line across the machine.

Still another object of the present invention is to produce a machine for grinding tumblers and stemware wherein a single belt is employed to drive a number of grinding shafts on the bed of the machine. The provision of a single drive belt is further advantageous as it eliminates a great deal of trouble caused by slipping of the belt, broken belts, etc.

Process for Making Clay Pots. U. S. 1,364,875. January 11, 1921. Clarence E. Fulton, of Tarentum, Pennsylvania, assignor to Pittsburgh Plate Glass Company.

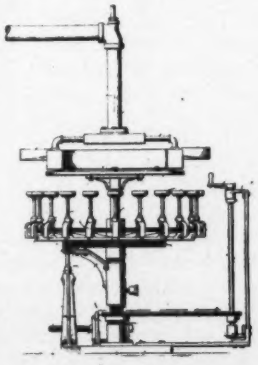
The invention relates to the making of clay pots and particularly such pots as are designed for use in the manufacture of glass such as optical and plate glass. It has for its principal objects the provision of a process (1) whereby the labor involved is reduced, (2) whereby the pot produced may be more quickly dried than has heretofore been the case with the ordinary hand made pots, and (3) whereby all air spaces or voids are eliminated and the clay batch compacted into a mass of uniform texture. Various forms of apparatus may be employed for carrying out the process.



It is the principal object of the present invention to improve upon the casting process heretofore used so as to secure a proper compacting of the clay and a uniform condition throughout the article produced, thus avoiding air spaces and giving a pot as reliable as those constructed by the hand process. Further, this object is accomplished by the use of a minimum amount of water, so that the pots may be dried in a relatively short time and without cracking due to shrinkage, and so that the process is applicable even to large pots having relatively thick walls.

Machine for Burning or Glazing the Edges and Sides of Glassware. U. S. 1,364,939. January 11, 1921. Albert Breakenridge Knight, of Fairmont, West Virginia.

This invention relates to new and useful improvements in machines for burning or glazing the edges and sides of glassware.



An important object of the invention is to provide means for simultaneously glazing the edges and sides of tumblers. A further important object is to eliminate the objectionable features present in this form of machine.

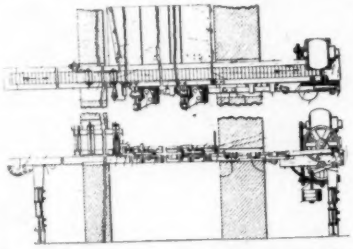
As at present constructed, machines of this type are provided with a number of spindles adapted to receive the tumblers in cups carried upon their upper ends. These spindles are raised and lowered by means of

a plate contacting the lower ends thereof. Such spindles used in practice are easily bent and must, therefore, be replaced. It will be understood that in a machine of this type, these spindles must necessarily be of some length, as the machine must be used for glazing very short tumblers as well as the long-stemmed type to be of any practical value.

In the construction of this machine it is so arranged that instead of raising or lowering the spindles themselves, a carrier for the spindles which may be raised or lowered is provided, thereby removing the thrust from the lower end of the spindle.

Lehr-Feeder. U. S. 1,363,609. December 28, 1920. Harry Walker McNaught, of Terre Haute, Ind., Assignor to Automatic Machinery Company, of Terre Haute, Ind.

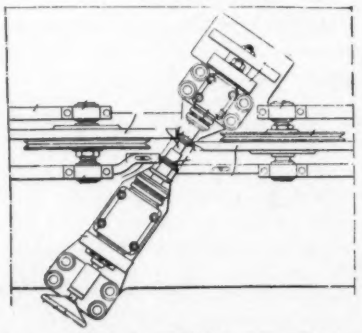
The object of this invention is to produce a machine which may be readily associated with glass lehrs of standard construction, by means of which freshly produced glass articles may be automatically charged into the lehr.



As shown in the accompanying illustration, the feeder includes a supporting frame in which is mounted an endless belt running lengthwise thereof and supported at one end by idler and at the other end by driving wheel. The frame is supported at its ends by suitable legs, which are adjustable in height. At intermediate points the frame is supported by plates laid in transverse openings formed through the side walls of the lehr-setting. The frame has a length considerably greater than the width of the lehr and is so arranged that its motor end will project only far enough from the lehr to protect the motor from the heat of the lehr, while its other end is projected to any desired distance either to receive freshly produced glass articles directly from the producing machine or from another endless carrier in a well-known manner, said endless carrier projecting either directly or indirectly through the producing machine.

Grinding-Machine for Beveling the Edges of Eye-Glass Lenses and Other Pieces. U. S. 1,365,448. January 11, 1921. Henry James Birchall, of Birmingham, England.

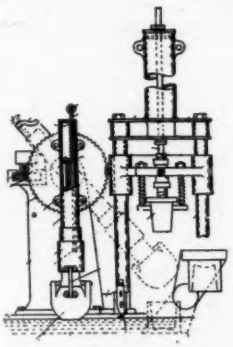
The invention, as shown in the accompanying illustration, provides an improved grinding machine for double, or beveling the edges of eye-glass lenses and other pieces.



The type of machine to which the invention relates is one in which the lens or piece to be beveled is separately revolved between the opposed peripheries of two grinding stones which in addition to revolving are moved, by the effect of weights under control of a former, to advance and retire them as they grind the lens or piece to the shape of the former. Said former revolves with the lens or piece on a shaft directed obliquely between the grinding stones, the one grinding stone grinding the one bevel on the lens edge, and the other grinding stone simultaneously grinding the other bevel on said edge.

Glass Gathering and Shaping Machine. U. S. 1,364,514. January 4, 1921. Michael J. Owens of Toledo, Ohio, assignor to the Toledo Glass Company, of Toledo, Ohio.

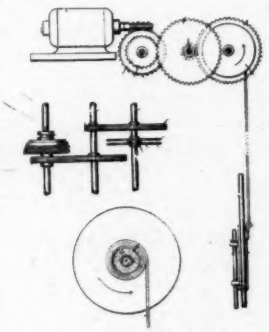
The invention consists in the construction of a machine designed to gather a definite quantity of glass from the mass and shape it into an article, consisting of a gathering machine and combined therewith the specific illustration of glass pressing mechanism to which the gathered glass is delivered and in which it is shaped into the desired form.



The inventor claims a machine for making pressed glassware having the combination of gathering mechanism, a mold, means for bringing said gathering mechanism and mold into alinement with each other with the gathering mechanism standing above the mold and for thereafter separating said elements. Also a presser above the mold and continuously in alinement with the receiving position of the mold, actuating mechanism for the presser, and a single rotatable supporting structure common to all of said apparatus.

Hoisting Mechanism. U. S. 1,363,622. December 28, 1920. Levi Sherman Skelton, of Okmulgee, Oklahoma.

This invention relates to hoisting mechanism for glass drawing apparatus, designed for the purpose of raising and lowering the draw-carriage, whereby the drawing tool is operated, the primary object of the invention being to provide a hoisting mechanism whereby the draw-carriage and drawing tool may be slowly raised at the beginning of the draw, and thereafter raised at a gradually increasing speed in the drawing out of the glass cylinder.

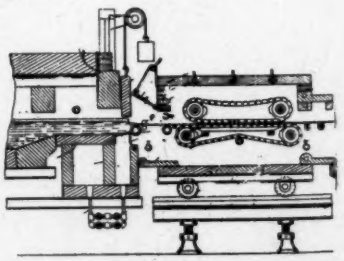


A further object of the invention is to provide a hoisting mechanism embodying a hoisting drum and cable, as shown in the accompanying illustration, and in which the construction is such as to cause the coils or convolutions of the cable, as they are wound upon the drum, to wind upon one another, whereby the effective diameter of the drum is gradually and progressively increased, to secure the result stated.

Another object of the invention is to provide a hoisting mechanism embodying a motor, preferably of the electrical type, driven at a substantially constant speed, in connection with a train of reducing gearing for driving the drum at a relatively reduced speed.

Sheet-Glass Drawing Apparatus. U. S. 1,362,378. December 14, 1920. James Whitemore, Detroit, assignor to The Libbey-Owens Sheet Glass Company, Toledo, Ohio.

This invention relates to a sheet-glass drawing apparatus, the combination of which includes a tank having a free lateral outlet through which the glass may flow and a traveling, cooled metal drawing lip below the level of the glass, over which the glass flowing out from the tank may be drawn.



Glass Factory Equipment and Supplies

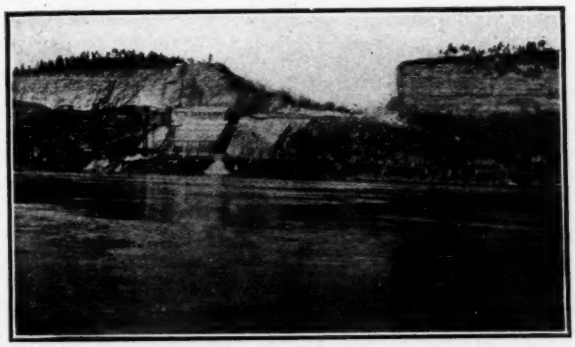
THE GLASS INDUSTRY will be glad to publish descriptions of new and useful devices, machinery and supplies of interest to the glass manufacturing trade. Most of the information printed in this department comes direct from the manufacturers of the products described.

The Chief Ingredient of Glass*

The use of sand in the manufacture of glass is a matter which, to the uninitiated, is more or less vague. The average person knows that sand is one of the principal ingredients in the making of glass, but that is about all.

And because it is such a common substance and is found on beaches, river bottoms and, in fact, all over as one of the very basic geological elements of the earth's surface, he rather unconsciously figures that all you need to go with it is a little heat and presto—you have glass.

But the kind or quality of sand that is employed in glass making is of the utmost importance. The color, transparency and brilliancy of the glass are very largely determined by the chemical and physical properties of the sand itself.



ONE OF THE RARE CASES WHERE THE BIGGER THE "BLUFF" THE MORE "SAND" IS BEHIND IT

This raw material must analyze 99 per cent pure silica or silicon dioxide (SO_2) in its natural state, be perfectly dry in order to mix properly in the batch, and contain no particles that will not pass through a ten-mesh screen.

Nature has deposited a sandstone that analyzes very much as the above, but, like many desirable things, she has hidden it deeply in her bosom so that it is difficult to get at.

The sand that we use in our various glass factories is a beautiful snow-white product that looks like pulverized sugar. It is not a commodity that we can scoop out of the lake nor the river bottom, but has to be quarried as though it were marble or granite, then crushed by machinery and put through a drying process.

In our quarry on the Missouri River, for instance, from which we get the sand that is used at Alton, the vein of sand stone is covered in some places with from two to ten feet of dirt. This is washed off by means of high water pressure, administered through a hose with a small nozzle.

In other places two to ten feet of low grade lime stone must be removed and wasted. Then a vein of silica is reached that is only good for steel casting molding sand.

This vein is drilled with air drills, quarried, and, after being treated, is sold to the steel foundries. The next forty to sixty feet is a very high grade glass sand stone, which must be drilled and blasted with great care so as to keep it separate from the molding sand. The latter is a much harder stone and the grains are more firmly bound together.

The raw material is then hauled to the mill where it is passed through a large gyratory crusher and then fed to two pairs of large rollers.

*From *Bottles*, published by Illinois Glass Company.

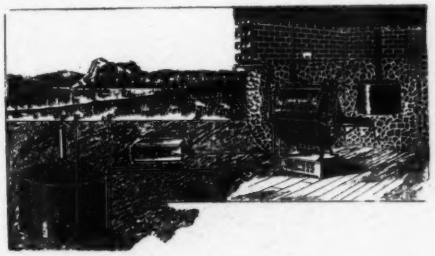
It is then dried and all the coarse sand screened out—the fine going into the material bins to make up the first grade glass sand, while the coarser particles are carried to additional rollers and all the foreign matter removed by means of a shaker screen. This second crushing produces a grade of material that is just what is required for cores in the manufacture of brass, iron and steel castings.

From this brief description it is seen that in order to obtain the high grade of sand necessary for making glass a large part of the raw materials mined must be either thrown away and wasted, or, where possible, utilized for other purposes.

The Tirrill Gas Machine

The failure of the natural gas supply to glass factories has led to the installation at many of the affected plants, of various types of gas making equipment heretofore used to a limited extent only in the glass industry. The Tirrill machine for making industrial gas has been extensively employed for many years in other industries, and this naturally resulted recently in its introduction into the glass field as a substitute for natural gas for any service requiring a small or moderate uniform flow of gas for any purpose.

The Tirrill fuel gas plant consists principally of a combined gasoline storage tank and generator which is buried underground at a distance from the building. In the building a blower or air pump is located which provides air which is piped to a carburetor in the storage tank. The air, in passing around and through the channels of the carburetor, is impregnated with gasoline vapor which then goes to the mixer, which, like the storage tank is buried underground, where it



is thoroughly mixed with additional air coming from the blower or air pump, and forced out through the slotted sections of the mixer into a delivery pipe, ready for use.

It is claimed by the manufacturers that the Tirrill machine is the highest type of gasoline gas-producing machine in the market and that it is successfully applied to all purposes, from the simple cooking of a meal to intricate heating problems. The machine is entirely automatic. No heat is necessary to vaporize the gasoline. No steam, electricity or fire is used to generate the gas. The Tirrill machine is approved by the National Board of Fire Underwriters. It is claimed that three gallons of gasoline will produce 1,000 cu. ft. of Tirrill gas delivered in a steady, uniform flow.

The pamphlets issued by the company give the names of many prominent industrial plants in which their machines are used, including a number of well-known glass factories. Further information regarding this process and machine may be had from the Tirrill Gas Machine Lighting Company, 103 Park avenue, New York.

Glass Container Industry Menaced by the Haugen Bill

The Haugen Bill (H. R. 10311) was introduced into and passed by the House of Representatives without warning before the trade became aware of the dangerous possibilities in it for the glass container industry.

The bill is an attempt to bring under the ban of the Pure Food and Drug Act, certain types of glass containers, on the theory that they are so made, formed and shaped as to deceive or mislead the purchaser as to quantity, quality, size, kind or origin of the food therein.

Should this bill pass the Senate and become a law it will do tremendous damage, not only to the thousands of packers and bottlers of foods, drinks and drugs in glass, and to the manufacturers of machinery and supplies for the packing industry, but also to the makers and handlers of glass containers, to the glass factory equipment and supply trade, to the manufacturers of caps, corks, cartons, shipping cases, labels and other accessories. It will cause immense losses by compelling manufacturers to throw on the junk heap hundreds of thousands of dollars' worth of molds, cartons and other supplies.

It will tend to destroy millions of dollars' worth of good-will for those packers and bottlers who have chosen for their products distinctive glass containers in which their own individuality can be expressed.

The glass industry stands for honest packing and full measure, but it opposes the Haugen Bill because it would be indefinite in its interpretation and administration. No manufacturer would know what kind of a bottle he could lawfully make. If the present bill be passed and become law, then no bottle manufacturer can afford to make up any particular bottle without first getting the approval of the Secretary of Agriculture. Even then he is not safe, because the Secretary of Agriculture is not always the same person and a succeeding Secretary might have an entirely different view. On the other hand, there is nothing to prevent the same department from changing its own judgment as to how the law should be interpreted, not only once but several times.

If the Department should carry out what seems to be the full intent of this Act it would prohibit the manufacture of every style or kind of bottle except a round one, with the very shortest possible neck, because every bottle that departs, even in a small way, from plain round would have in it qualities that could be said to make it "likely to deceive or mislead," and if this were followed out, all standards of design and artistic arrangement intended to make the package attractive would be reduced to the lowest level of the commonplace.

The law would be dangerous because it would place arbitrary power in the hands of department inspectors and present opportunities for dishonest practices. In discussing the measure before the House, Congressman Mann said in part: "I do not want to leave it to a department clerk or a clerk in the office of the solicitor of the Agricultural Department to say as between two men on his new inspection, 'I think you are violating the law and should go to the penitentiary,' when no one can tell in advance how he is going to obey the law."

The bill says, "or if it be in a container so made, formed or shaped, as *likely* to deceive or mislead the purchaser, etc."

Does it not seem ridiculous to think that a transparent glass bottle, with the exact quantity of the contents plainly printed on the label, could be "likely to deceive or mislead"? The passage of this bill will assume that the public has a lower standard of intelligence than is generally accredited to it.

The Glass Container Association and the National Bottle Manufacturers' Association have been very active in opposition to the Haugen Bill. At their suggestion many of the packers, the glass manufacturers and the supply firms catering to these industries have telegraphed to their Senators protesting against the bill, but there are still many others who have not done so, whose help is urgently needed, and all, even those only remotely concerned, are requested to register emphatic protests with their Senators, giving specific reasons why hardships will result from the passage of the law, and to send copies of their telegrams to Judge I. G. Jennings, business manager, Glass Container Association, 70 Fifth Avenue, New York.

British Glass Prices Investigated

A report has been issued by the British parliamentary standing committee on trades covering an investigation made by the committee into conditions in the glass trade. After thoroughly investigating the changes brought about by the introduction of modern machinery and methods, and describing various influential organizations in the industry, the report concludes as follows:

1. There are in the trade several associations, of which the most important is the Association of Glass Bottle Manufacturers of Great Britain and Ireland.

2. The prices fixed from time to time by this association are minimum selling prices, and are the same for bottles produced by the "Owens" machine as for those produced by hand. In actual practice we find that these minimum prices are not ruling prices, for manufacturers' charges are invariably above these fixed prices.

3. The British Glass Industries, Ltd., is a powerful combination, and is in a position to exercise considerable influence in the trade with regard to prices. We are not satisfied that its financial history is consistent with a reduction in prices, and we are of the opinion that, having regard to the profits that have been made in recent years, the prices of bottles are unduly high, and that, in view of the greatly reduced cost of production likely to be brought about by the extended use of the "Owens" automatic machine, very substantial reduction in prices ought to be enjoyed by buyers in the near future.

4. The manufacturers of scientific glassware have incurred considerable losses since they undertook to manufacture this class of glassware, and although we are not able to report as to fairness or unfairness of past and present prices, we consider that such temporary support should be afforded to this new industry as is consistent with fairness to consumers.

Glass Companies Should Co-operate with A. C. S.

No one derives greater material benefit, in the long run, from the work of the American Ceramic Society than the corporations engaged in the manufacture of ceramic products, yet the names of only a lamentably small number of glass companies are enrolled in the society as corporation members. An organization of this type ought to have the moral, as well as the financial support of the whole industry. Obviously the simplest and most direct way of giving encouragement to and accelerating the activities of the American Ceramic Society is to join and take an active part in them. Included in the list of corporation members are the following glass manufacturers and glass works engineering and supply concerns:

Bausch & Lomb Optical Co.
Buckeye Clay Pot Co.
Consolidated Window Glass Co.
H. L. Dixon Company.
B. F. Drakenfeld & Co., Inc.
Findlay Clay Pot Co.
Edward Ford Plate Glass Co.
Frink Pyrometer Co.
Gillinder Brothers.
Harbison-Walker Refractories Co.
Harshaw, Fuller & Goodwin Co.
L. J. Houze Convex Glass Co.
Illinois Glass Co.
Jefferson Glass Co.
Jeffery-Dewitt Co.
Johnston Brokerage Co.
Laclede-Christy Clay Products Co.
Macbeth-Evans Glass Co.
Maine Feldspar Co.
Monogah Glass Co.
Norton Co.
Pennsylvania Salt Mfg. Co.
Phoenix Glass Co.
Pittsburgh Plate Glass Co.
Roessler & Hasslacher Chemical Co.
United States Glass Co.
Vitro Manufacturing Co.

It is hoped that many other corporations will become members.

Secretary Binns requests those who contemplate doing so to make application promptly, so that their names may be included in a new list to be issued on March 1.

Program and Plans of the Columbus Meeting of the American Ceramic Society

All indications point to a very large and successful gathering at Columbus, Ohio, for the twenty-third annual meeting of the American Ceramic Society, which will take place at the Hotel Deshler, February 21 to 24, inclusive. Secretary Charles F. Binns announces that nearly twice as many acceptances as last year have been received and that over one hundred papers are on the program.

The following schedule of meetings and other activities has been planned:

Monday, February 21

Morning—Registration.
President's address.
Business Session.
Afternoon—Reading of general papers.
Evening—Smoker and Section Q, free to members and guests.

Tuesday, February 22

Morning and Afternoon—The four industrial Divisions of Glass, Refractories, Enamels, and Terra Cotta will hold separate meetings at which divisional papers will be read and discussed.
Informal conferences and discussions will be held by three separate groups interested, respectively, in Decorative Processes, Heavy Clay Products, and White Ware, with a view to the formation of new divisions.
Evening—Annual Banquet, Hotel Deshler.

Wednesday, February 23

Morning—Completion of literary program, either by divisions or in general session.
Afternoon—Closing business session, installation of officers.

Thursday, February 24

Morning and Afternoon—Trips to Ohio State University, industrial plants, etc.

The local committee has made attractive plans for the entertainment of the visitors, with special arrangements for the ladies who accompany members, including luncheons, a matinee, and a visit to the university.

A list of Columbus hotels, with their rates, may be found in the January issue of THE GLASS INDUSTRY.

Glass Division Has Interesting Program

Dr. E. Ward Tillotson, secretary of the Glass Division, announces that an excellent program has been arranged for the meeting of the Glass Division on Tuesday, February 22. The following are the titles of papers which will be presented:

The Training of the Glassworks Chemist
Alexander Silverman, Pittsburgh, Pa.

Raw Materials for Glass Making
C. W. Williams, Cleveland, Ohio

Some Chemical and Physical Data on Glass Sands
W. F. Brown, Charleston, W. Va.

Composition of Barium Glass
R. J. Montgomery, Rochester, N. Y.

Transparent Colored Glass
E. L. Hettinger, Reading, Pa.

Dissolved Gases in Glass
E. W. Washburn, Urbana, Ill.

A Thermal Study of Some Members of the System PbO-SiO_2
L. I. Shaw and B. I. Ball, Washington, D. C.

The Composition of the Gases Dissolved in Commercial Glass
E. W. Washburn, F. F. Footitt and E. N. Bunting, Urbana, Ill.

Some Considerations in the Construction and Use of Pot Arches
J. L. Crawford, Pittsburgh, Pa.

Physical Defects in Tank Blocks
Geo. A. Loomis, Corning, N. Y.

The Design and Operation of Glass House Furnaces
F. J. Denk, Pittsburgh, Pa.

An Electrically Heated Glass Annealing Leer
E. F. Collins, Schenectady, N. Y.

The Operation of Leers
C. E. Frazier Washington, Pa.

The Glass Industry in India
G. P. Ogale, Pittsburgh, Pa.

*The Choice of Glass Batches Containing Lime
W. E. S. Turner, Sheffield, England

*The Motion of the Stirrers Used in Optical Glass Manufacture
E. D. Williams and L. H. Adams, Washington, D. C.

*The Importance of Analysis in Purchasing Raw Materials for the Glass Industry
Alexander Silverman, Pittsburgh, Pa.

*The Manufacture and Use of Rolled Optical Glass
H. S. Roberts and J. C. Hostetter, Corning, N. Y.

*The New Factory of the Monongah Glass Company
E. W. Tillotson, Pittsburgh, Pa.

*Published in the Journal of the American Ceramic Society. Discussion invited.

The program has been limited to allow ample time for discussion of the papers and for general discussion of topics which may be suggested at the meeting. It is anticipated not only that a new record for attendance will be set but also that the program will be of special interest to all connected with the glass industry.

Everyone interested in glass, whether a member of the society or not, is cordially invited to attend the meeting and to take part in the discussion.

Important business matters will come before the Glass Division, including the election of officers, consisting of chairman, vice-chairman, secretary, and two councillors to take the places of Charles O. Grafton, of the Gill Clay Pot Company, and H. L. Dixon, of H. L. Dixon Company, whose terms of office expire. Several amendments to the by-laws will be proposed, with a view to facilitating the affairs of the division. Another matter due for action is the Bureau of Standard's recommended specifications for limestone, quicklime and hydrated lime for use in the manufacture of glass.

New Editor for A. C. S. Journal

Dr. E. W. Washburn, Director of Ceramics at the University of Illinois, has been appointed editor of the *Journal of the American Ceramic Society* to take the place of Homer F. Staley, who was obliged to resign owing to the pressure of other duties. Dr. Washburn comes to the post well equipped technically and with a broad knowledge of the practical needs of the ceramic industries.

The 1920 Year Book of the National Association of Cost Accountants which has just been published is an attractive volume which ought to prove of real value to all men interested in cost work. In addition to the reports of the various officers and committees and a list of the members of the association, it contains a complete report of all the papers delivered at the annual convention at Atlantic City, N. J., together with the discussions which followed each of these papers. The Atlantic City convention was probably the most important gathering of cost men which has been held in this country and the opinions of the men who took part in this conference are worthy of study.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS will hold its spring meeting at the Congress Hotel, Chicago, Ill., May 23 to 26. Sessions have been planned by the professional sections on aeronautics, fuels, managements, material handling, machine shop, power, forest products and railroads.

Trade Conditions in Europe

Special Correspondence to THE GLASS INDUSTRY

Conditions in Lorraine

Besides the tremendous iron and coal industry, Lorraine boasts of a highly developed glass industry, the principal centres being at Dreibrunnen (near Saarburg), Chateau-Salins, Borbach, St. Aurin (near Loerchingen), Goetzenbrueck, Meisental and Muenztal (near Bitsch). The latter three, located in the district of Saargemuend, are by far the most important. A principal market for medium ware is Muenztal—which, by the way, claims to possess the largest oven in the world, with 24 melting pots. Goetzenbrueck lays claim to being the largest eyeglass manufacturing centre of the world. Before the war, approximately 1,000 hands were employed, which number has now shrunk to about 800, producing chiefly watch glasses and eyeglasses, the pre-war output of which amounted to approximately 11,520,000 of the former, and 960,000 of the latter. Business in the aforementioned lines is anything but bright at present and part of the operatives are drawing unemployment benefits. The firm of Walter Berger & Company recently extended their plants with a view of taking up new lines and bringing the manufacturing processes up-to-date. Business at Meisental is fairly satisfactory. The separation from the German markets is being keenly felt and part of the eastern market has been lost to Japan through the exigencies of the war.

Output in the Saar district up to June last amounted to about 26,910,000 sq. ft., of which 75 per cent were taken over by a French group for reconstruction work in the devastated territories. At present the larger part of production is finding its way to Germany. According to reports on hand, an English company is contemplating the acquisition of the Fourcault patents with a view of introducing this process—which is claimed to have yielded satisfactory results in Czecho-Slovakia, in France, England, Holland and Greece.

Developments in Germany

TREND OF TRUSTIFICATION IN THE GERMAN GLASS INDUSTRIES

Never before in the history of the development of modern industrial Germany has the tendency for transactions on a large scale, company fusions, mergers, and "Interessengemeinschaften" (communities of interests) been so pronounced as of late. The recent mergers and interests agreements in the mining and steel industry were still fresh in everybody's mind when the aniline dye concern took the public by surprise through the establishment of a new limited company (which has taken over the nitrogen works at Oppau and Merseburg, hitherto operated by the "Badische Anilin und Sodafabriken") with a capital of 500 million marks for the purpose of placing the contemplated extension of nitrogen production on a secure financial basis. It would be erroneous to infer that this tendency for concentration of interests and power is confined to the aforementioned industrial groups, for there are distinct signs that a similar tendency exists in other industries as well and recent developments in the glass industry would tend to show that the trustification of this industry, too, is by no means outside the realm of possibility. A beginning seems to have been made with the fusion of the two largest concerns engaged in the manufacture of electric bulbs, the "Allgemeine Elektrizitaets Gesellschaft" and the "Siemens & Halske Aktien Gesellschaft" at Berlin, with one of the leading glass work making a specialty of producing glass bulbs, the "Vereinigte Lausitzer Glaswerke" at Weisswasser. The fusion was principally dictated by the alleged existing "Ueberfremdungsgefahr," i. e., a tendency on the part of foreign capital interests to obtain a decisive influence over the control of the company. Parenthetically it may be remarked here that this "Ueberfremdungsgefahr" is being made the stock tale of many companies desirous of concealing huge profits. The trick is generally done by issuing preference shares with multiple voting power, as, for instance, tenfold or twelvefold voting power or even higher. Dr. Walter Rathenau, speaking on behalf of the electrical concern, pointed out that it was of utmost importance for the German electric bulb industry to gain an influential control over the production of bulbs, inasmuch as the quality of the finished products depended upon the technical development of the glass works. At the extraordinary general meeting held on December 8, it was therefore decided to incorporate the bulb section of the Vereinigte Lausitzer Glaswerke in the "Osram Kommandit Gesellschaft," a company jointly established by the two electrical concerns which was consuming already the largest part of the output of the Lausitz glass works. The rest of the property of that company was taken over by the two electrical concerns. Opposition on the part of a minority failed to influence the decisions of the meeting and it is interesting to note that Dr. Rathenau intimated the intention of the electrical concerns to build glass works of their own should the motion for a merger be negatived.

At a recent sitting of the Committee of the Window Glass Section of the Foreign Trade Control Bureau for Glass the export restrictions for window glass were considerably relaxed. Export permits have been granted for approximately 30 per cent. of the total output for a period of three months for a start and an increase of this quantity is considered probable should the coal and raw material supply improve. The quantity thus released for export represents about 12,920,000 square feet and will be distributed among industry and trade. It is also interesting to learn that on the instigation of the export firms it was decided to drop the clause by which German exporters were hitherto bound to invoice their bills in foreign currency.

Sheet-glass works in Silesia, Lusatia and Saxony have recently established an "Export Bureau of Eastern and Central German Sheet Glass works" with its seat at Berlin. The purpose of the new enterprise—a limited company—is to take charge of the foreign sales distribution of a part of the monthly output of window glass, approximately 20 per cent. Practically all works in the aforementioned districts have joined.

The "Association of German Glass Merchants" at Crefell, the "Association of Eastern-German Glass Merchants" at Berlin, and the "Protective Association of Plate Glass Merchants of Eastern Germany" at Berlin have jointly established a new central organization at Berlin under the name of "Verband des deutschen Flachglas-Grosshandels."

At a meeting of the Works Councils at Dresden, representatives of the glass industry stated that owing to the coal shortage several big orders running into millions of marks had to be refused.

On account of the growing unemployment at the Zeiss works at Jena, the Works Council has applied to the Thuringian State Council with a view of procuring orders for educational instruments and scientific apparatus from the Federal Government.

Czecho-Slovakia

A decided improvement in the quality of products as well as a tendency to reconstruct plants on modern lines is noticeable in the Czecho-Slovakian glass industry. Practically all the larger works are investing comparatively big sums in the extension and modernization of plants and a number of new works have sprung into existence. Special attention is being given toward a development of the sheet, crown, bottle and hollow ware lines. The following statistics show production during the first half of 1920: Hollow ware, 368 million kronen; luxury ware, 147 million kronen; cast glass, 35 million kronen; Gablonz ware, 571 million kronen; rings, 57 million kronen.

The export total for the first half of 1920, not including window glass, amounts to 1087 million kronen. The button and bead industry, however, reports a lag in sales of late, owing to high prices which, manufacturers assert, do not allow of any reductions so long as raw materials remain at their present high level. The demand for buttons and beads is reported to be very keen.

Russia

The *Pravda*, a Soviet newspaper published in Moscow, in detailing the Russian industrial situation, states that the production of glass in Russia during the first six months of 1920 amounted to 15 per cent of the production in the corresponding periods in 1913 and 1914.

Trade News

All Items Verified Unless Otherwise Indicated

The plant of the CROWN STEAM BOTTLING WORKS, Clearfield, Pa., was recently destroyed by fire with a loss of $30,000. The company will build a modern plant, 30 by 176 feet.

THE WHITALL-TATUM COMPANY, Millville, N. J., has contracted for the construction of a two-story building, 35 by 105 feet, to be used for the manufacture of glassware.

H. L. DIXON COMPANY, Pittsburgh, Pa., will have the same complement of officers as heretofore, all having been re-elected for the current year at the annual meeting of the company held on January 18.

THE TWIN CITY GLASS COMPANY, Texarkana, Ark., has installed oil-burning apparatus, which will be used in case of emergency when the gas supply is low. The factory, which has been closed down, is expected to resume operations early in the spring.

THE ADAMSON MANUFACTURING COMPANY, East Palestine, O., has added a new department for manufacturing all kinds of storage, pneumatic and pressure tanks, welded pipe, battery casings, evaporators, condensors and a large line of arc-welded products.

THE AETNA CUT GLASS WORKS, INC., Bridgeton, N. J., was recently incorporated, with a capital of $100,000, to take over the plant of the Aetna Cut Glass Company, also of Bridgeton, N. J. The incorporators were: J. A. Nixon and L. Colby, of Philadelphia, Pa., and Charles D. Link, of Bridgeton.

THE WILSON CHEMICAL COMPANY, 108 Fulton street, New York, importers and dealers in chemicals for the glass trade, announces that Charles Glass has become associated with their organization. Mr. Glass was formerly connected with the Butterworth-Judson Corporation and for the past two years has been manager of J. C. Wiarda & Company, Brooklyn, N. Y.

THE AMSLER-MORTON COMPANY, Pittsburgh, Pa., has received an order for 90-foot continuous lehrs from the Hammers Glass Works, Askersund, Sweden. These lehrs are to be used in conjunction with Owens bottle machines and Owens carry-in device and the installation is to be similar to that being built for the Owens Bottle Company at Charleston, W. Va.

A special meeting of the stockholders of the ALLEGHENY PLATE GLASS COMPANY will be held at the offices of the company at Glassmere, Pa., on February 15. The purpose of the meeting is to vote on the question of increasing the indebtedness of the company by $1,500,000. The proposed action has already been approved by the directors, who voted to place the matter before the stockholders.

C. G. HEILMAN has become connected with the Simplex Engineering Company, Washington, Pa., as field man, and will specialize in producer gas problems for the company. Mr. Heilman has had wide experience in this line of work and was associated with the R. D. Wood Company, Philadelphia, Pa., for seven years, and the Camden Iron Works, Camden, N. J., for several years in the same line of work.

The board of directors of the CENTRAL GLASS WORKS, Wheeling, W. Va., at a meeting held on January 21, re-elected the following officers for the ensuing year: Howard Hazlett, president; A. S. Hare, vice-president; Edward J. Schaub, secretary; J. C. Fee, treasurer and general manager, and James Steadman, superintendent. The executive committee of the company will include Howard Hazlett, A. S. Hare and James Steadman.

The annual stockholders' meeting of the UNIVERSAL GLASS PRODUCTS COMPANY, Parkersburg, W. Va., formerly the Brown Tumbler Company, was held January 28. Following the stockholders' meetings, a meeting of the board of directors was held and the following officers were re-elected for the ensuing year: F. W. Milligan, president; F. J. Glass, vice-president; R. S. Davis, treasurer, and C. J. O'Connor, secretary.

THE CORNING GLASS WORKS, Corning, N. Y., has awarded a contract to Dwight P. Robinson & Company, Inc., New York, for an addition which will double the capacity of the present power plant. The addition will be two stories high, of brick and concrete, to match the present building. It will shelter two 420-horsepower boilers. Provision will be made for taking water from the Chemung River for cooling and steam purposes, and water-softening equipment will be installed.

The following officers were elected at a recent annual meeting of the DAVIES GLASS AND MANUFACTURING COMPANY, Martins Ferry, O.: Thomas W. Pursglove, president; Ernest K. Hoge, vice president; W. E. Thomas, treasurer; A. J. Fallen, secretary, and W. W. Davies, general manager. The board of directors includes: Thomas W. Pursglove, Ernest K. Hoge, W. E. Thomas, George L. Spence, Fred L. Selby, James H. Beans, W. W. Davies, J. E. Reynolds, R. H. Wilson, E. N. Boggs, and A. J. Fallen.

B. G. Landau, general manager of the WEST VIRGINIA GLASS MANUFACTURING COMPANY, Westmoreland, W. Va., announces that the directors of the company have decided to increase the capacity of its present plant. Eight automatic blowing machines are to be installed in place of the two machines as originally planned. This extension of equipment, it is said, is made necessary by the accumulation of unfilled orders on the books of the company. The products to be manufactured include jars and glass containers of various sorts.

THE MOUNT UNION REFRACTORIES COMPANY, Mount Union, Pa., has changed its name to the United States Refractories Corporation, and its new plant will be located near Woodland, Clearfield County, Pa. It was considered advisable to change the firm's name on account of the company entering into the manufacture of fire clay refractories, but this does not in any way affect the personnel, management or ownership. The officers of the company are: R. P. M. Davis, president and general manager; J. O. Heitsenrether, sales marager; V. L. Wallett, secretary and treasurer, and C. V. Hackman, assistant to the president.

The annual meeting of the stockholders of the PITTSBURGH CLAY POT COMPANY was held at the company's offices, 1247-1261 Reesdale street, North Side, Pittsburgh, Pa., at which time the officers and directors of the company were re-elected, as follows: President, A. H. Heisey; treasurer and general manager, A. E. Gray; secretary, J. E. McKelvy; superintendent of manufacturing department, Thomas F. Emminger. The directors are as follows: J. H. Challinor, William C. King, Andrew P. Duncan, Thomas Evans, James Hogan and Dos Taylor. The report submitted

to the stockholders showed that the company, which is one of the oldest clay pot manufacturers in the country, did the largest business in its history during the past year.

THE AUTOMATIC MACHINERY COMPANY, Terre Haute, Ind., announces that W. H. Johnson, representing the Company, while in Toledo recently discussed with M. J. Owens of the Owens Bottle Company, the features of their carrying-in-devices for handling glassware automatically from the blowing machines to and into the lehrs, and as a conclusion, the Owens Bottle Company will recommend the Automatic Machinery Company's conveyor systems to glass factories. The Company states that during the year 1920, several installations of "Automatic" lehr feeders and conveyors were made in this country, as well as in several foreign countries and prospective business for the ensuing year appears to be very bright.

An unconfirmed newspaper report states that construction has begun on a new factory for hollow glassware for the CO-OPERATIVE GLASS COMPANY, Los Angeles, Cal. W. C. Blank, formerly superintendent and production manager of the Illinois-Pacific Glass Company is named as the organizer of the new enterprise, which is capitalized at $500,000 of which $300,000 is said to have been subscribed for by employees and officials connected with the plant. An investment of $120,000 in land and buildings will include a main building with furnace capacity of fifty tons a day of finished ware, a mold shop and other departments. Completion of the plant is expected by May 1 of this year. Soda ash from nearby California deposits will, it is stated, be used.

THE SIGWART & ROLSTON MACHINE WORKS have moved to their new location at 1312-14 Sheffield street, N. S., Pittsburgh, Pa., where they are housed in their own building, which gives them about 10,000 sq. ft. of floor space. This will enable them to double their previous output and they are preparing to place on the market a new line of glass factory machines possessing many modern features.

The first of the group to be placed on the market will be their Type C sand blasting machines, designed for sand blasting tumblers, electric and gas shades, perfumers' ware, auto lenses, ground glass for photographic purposes, electric bulbs, domes, etc.

At the present time the company manufactures tumbler and chimney glazing machines, cracking-off machines, crimping machines, presses, and iron molds for pressed and blown glassware.

K. P. Rolston is president of the company and has supervision of the engineering department, and Charles E. Schmunk is in charge of the design of glassware and the manufacture of molds and glass machinery.

Ford Motor Glass Plant Closed

With the shut down at the first of the year at the Ford Motor Company's plant at Detroit, Mich., the experimental glass plant in that factory was also closed. In this plant the Danner patents for drawing finished sheet glass continuously were being developed under the personal supervision of the inventor, Edward Danner.

The object was to produce sheet glass of the commercial equivalent of plate glass for windshield purposes, which would not require grinding and polishing. The experimental work was directed to apparatus which would produce sheet glass without a streaky and glary appearance. The inventor reports that great strides had been made along this line during the short period of operation and that it was evident from the quality of the glass at the time of the shut down, that the machine could be operated for the production of window glass. While the machine was not operated on a commercial scale, it produced some excellent quality of glass at a speed of 7 to 15 linear feet per minute and it was thought with the improvements under construction that a quality suitable for windshields would be obtained. The indications are now that this work will not be continued in the near future at the Ford Motor Company, but the inventor is now considering plans for the continuation of the work and the application of the machine to production elsewhere.

West Virginia Trade Conditions

A report has been made by the West Virginia Department of Labor of a survey which has been in progress during the past few weeks covering conditions in the glass trade in the State. There are about seventy-five glass factories in West Virginia and the report shows that a majority of them have been shut down. Only the bigger plants, which have large unfilled contracts on hand, are operating extensively, and even they are not running at anything like full capacity. Two plants of this class are the Libbey-Owens Sheet Glass Company and the Owens Bottle Company, with factories at Fairmont and Charleston.

The report to the State Department shows that the glass trade has been affected more unfavorably by the slump in business than almost any other line, but the general feeling among the glass factory officials is one of hopefulness for the future. Owing to the lessening demand for fuel from all industries of the State, the glass plants have not suffered from shortage of fuel as much this winter as in former years. In discussing the situation one glass company states, "Belgium is quoting an average of $2.33 per box less for common window glass delivered in New York than the American price and something has to be done in the way of tariff protection by Congress in order to protect the American manufacturer and at the same time there must be a reduction in the wages of skilled labor, which scale is adjusted periodically between the workers and manufacturers, according to the price paid for window glass." The consensus of opinion throughout the trade is that wages will have to be cut materially before the plants can be put in operation on a profitable basis.

Foreign Trade Financing Corporation

The sale of $100,000,000 capital stock of the Foreign Trade Financing Corporation has begun. The new corporation, charter of which was recently approved by the Federal Reserve Board, and the presidency of which has been tendered to W. P. G. Harding, governor of the Federal Reserve Board, is the first big step backed by the business men, bankers and producers of the country to extend long term credits to foreign buyers of American goods, and thus to break the threatened paralysis of our international trade.

In regard to the functions of the corporation, the prospectus states:

"An Edge Act corporation may, under the law, extend long and short term credits, invest in securities, purchase bills of exchange, engage in foreign banking, and in every lawful way aid in financing foreign trade. It may likewise, with the approval of the Federal Reserve Board, issue and sell to the investing public its own notes and debentures to an aggregate amount of ten times its paid-up capital and surplus. It may not engage in the general business of buying or selling goods or commodities in the United States, nor engage in domestic banking, except such as in the judgment of the Federal Reserve Board may be incidental to its international or foreign business.

"The Board of Directors of the corporation will consist of not less than thirty-six nor more than sixty members and will be representative of all sections of the country, as represented by the twelve Federal Reserve Districts. The various interests of the country as represented by agriculture, commerce, manufacturing and banking will have places on the board.

"While the object of the organization of the corporation is to satisfy a pressing need in our commercial and financial equipment and to serve the interests of the country as a whole, it will be a private institution whose first duty must be to preserve the safety of the investment of its stockholders and return a fair profit on that investment."

Important Postal News

The successful negotiation by the Post Office Department of a new Pan America-Spain Postal Convention most favorable to American foreign traders, is announced by the National Foreign Trade Council. This new Convention was drawn up during the Universal Postal Congress at Madrid.

It will become effective, so far as each country is concerned, when ratified by the government of that country. It is expected that the Convention will become operative for most of the signatory countries by the end of February. The exact date will in each case be announced by the Post Office.

By special agreement, pending ratification, this Convention has become effective February 1, 1921, between the United States and Bolivia, Colombia, Cuba, Honduras, Nicaragua and Peru.

Under the terms of this new agreement, the following benefits will accrue to American foreign trade:

Domestic rates of postage will be permissible on letters addressed to Spain and all countries of Central and South America.

Domestic rates of postage will also apply to single post cards, reply post cards, printed matter of all classes, commercial papers and samples.

The weight of packages containing books, papers and printed matter has been increased from 2 to 4 kilograms. In the case of single volumes, the weight has been increased from 2 to 5 kilograms. None of the dimensions of such packages shall exceed 45 centimeters.

Packages which have been previously rolled shall be transmitted as mail, provided their dimensions do not exceed 1 meter in length and 15 centimeters in diameter.

Commrcial papers shall be prepaid at the lowest rate fixed in the domestic rates.

Samples shall be transmitted freely by the mails, provided they have no commercial value and provided their dimensions do not exceed 30 centimeters in length, 20 in breadth and 10 in depth. If transmitted in the form of a roll, the maximum dimensions shall be 30 centimeters in length by 15 centimeters in diameter.

Samples shall not be transmitted at the rate below the one fixed in the domestic rates of the country of origin.

In the case of loss of a registered package, the sender shall have the right to an indemnity equal to the one fixed by the domestic legislation of the country of origin, up to and not exceeding 50 francs gold.

The only territory on the Western Hemisphere not included in this agreement is that of the possessions and dominions of European countries.

Books Received

American Bottles, Old and New.—A story of the industry in the United States, by William S. Walbridge, vice-president, The Owens Bottle Company, Toledo, Ohio, 1920.

The sub-title adequately describes the scope of this attractive volume, which contains in condensed form a great many interesting facts concerning the early history of glass making in the United States, followed by an account of the invention and commercial introduction of automatic machinery and the tremendous developments resulting therefrom.

Beginning with a reference to the first glass works in America, a bottle factory established at Jamestown, Virginia, in 1607 (and which it is interesting to note was the first industrial enterprise in the territory now included in the United States), the story follows the development of the industry down to the present period, with special reference to the invention and development of the Owens bottle machine and the great industrial organizations that have grown up around this epoch-making invention.

Foreign Trade Opportunities

Recent issues of the Daily Consular and Trade Reports issued by the Bureau of Foreign and Domestic Commerce, Washington, D. C., list the following items. Further information concerning any of them may be obtained from the Bureau or its district offices by duly registered firms and individuals, by written request giving opportunity number.

Registration in the Importers' Index entitles the registered firm to receive further information concerning items listed in the Daily Commerce Reports. Registration may be obtained by making application to the Bureau of Foreign and Domestic Commerce, Washington, D. C., or to one of the district or cooperative offices located in nearly all of the large cities, and by filling out "form 57." Registered firms receive additional circulars and bulletins of various sorts relating to their particular line of business.

34142.—A firm of commercial agents in India desires to secure the representation of manufacturers and exporters for the sale of glassware, etc. Quotations should be given c. i. f. Indian port. References.

34170.—A commercial representative in Spain desires to secure an agency on commission for the sale of glassware, porcelain, etc. Correspondence should be in Spanish or French. References.

34208.—A commission agent in India desires to secure an agency for the sale of glass. Quotations should be given c. i. f. Indian port. Terms: 30 days' payment against documents through any exchange bank. References.

34298.—A commercial representative in South Africa desires to secure an agency on a commission basis from manufacturers for the sale of glass bottles, etc. References.

34306.—A wholesale dealer in electro-technical lines in Switzerland wishes to get into touch with electrical bulb manufacturers with a view to purchasing these products. No reference offered.

34332.—A commercial agent in Turkey desires to secure the representation of manufacturers for the sale of caustic soda, soda ash, potash carbonate, etc. No reference offered.

34345.—An inquirier in Mexico who plans to manufacture perfumes and other toilet waters, desires to obtain suitable bottles for this purpose with name blown in the glass. Quotations are requested f. o. b. Mexico City. No references offered.

34359.—A decorative supply company in Wales desires to purchase plate glass. Quotations should be given f. o. b. any Atlantic port. Payment cash against documents. Reference.

34369.—An importing firm in Mexico desires to receive quotations f. o. b. New York or San Francisco for immediate delivery of window glass. Correspondence should be in Spanish. References.

Inquiries Received

Further particulars may be obtained from THE GLASS INDUSTRY.

No. 1.—We have an inquiry for machinery to make ordinary window glass and for flattening ovens. Can you refer us to concerns competent to furnish such equipment?

No. 2.—We want to obtain about two gross per month of one-gallon amber glass jugs with handles.

No. 3.—Kindly give us the names of concerns that make heat-resistant glass similar to Pyrex.

No. 4.—We desire information regarding the various types of annealing lehrs, with a view to ascertaining their adaptability for a special process of applying labels to bottles, in which we are interested.

No. 5.—Kindly give us the names of concerns from whom we can obtain molds for glass letters for illuminated advertising signs. We expect to need complete sets of 8- and 12-inch letters.

No. 6.—A manufacturing optical firm is in need of several kinds of optical glass, including a standard colored lens made in flat sheets or plates, and a colored lens to be made to special specifications in goodly quantity.

MONTHLY SUMMARY OF FOREIGN COMMERCE OF THE UNITED STATES.

Corrected to December 29, 1920.

IMPORTS OF GLASS AND GLASSWARE.

Articles	November 1919 Quantity	November 1919 Value	November 1920 Quantity	November 1920 Value	Nine months ending November 1918 Quantity	Nine months ending November 1918 Value	Nine months ending November 1919 Quantity	Nine months ending November 1919 Value	Nine months ending November 1920 Quantity	Nine months ending November 1920 Value
Glass and glassware:										
Bottles, vials, demijohns, carboys, and jars, plain, ordinarily used as containers, empty or filled ....lbs. dut.	319,340	15,394	1,274,185	$38,633	.....	$104,708	1,837,469	$100,123	6,432,646	$279,174
Bottles, decanters, and other glassware, cut or ornamented....dut.	.....	70,655	.....	147,332	.....	212,181	.....	392,412	.....	1,081,249
Optical instruments, including lenses and spectacles ....dut.	.....	67,922	.....	95,614	.....	135,808	.....	290,618	.....	843,201
Sheet and plate glass—										
Cylinder, crown, and common window glass, unpolished ....lbs. dut.	247,926	41,286	711,547	68,533	418,705	50,581	919,624	125,738	5,054,360	518,221
Plate glass, cast, polished, unsilvered. sq. ft. dut.	.....	.....	433,900	464,544	273	210	4,173	3,055	2,214,216	1,958,036
Plates or disks, rough-cut or unwrought, for optical purposes....lbs. free	69,801	51,330	99,928	77,778	.....	321,284	555,227	384,558	836,552	894,130
All other ....dut.	.....	58,791	.....	271,886	.....	443,170	.....	554,919	.....	2,007,232
Total	.....	305,378	.....	1,164,320	.....	1,267,942	.....	1,851,423	.....	7,581,243

EXPORTS OF GLASS AND GLASSWARE.

Glass and glassware:										
Bottles, demijohns, carboys and jars.....	.....	$607,956	.....	$756,296	.....	$2,579,773	.....	$4,749,497	.....	$8,763,683
Chemical glassware	.....	28,324	.....	20,196	.....	167,066	.....	184,903	.....	223,834
Common window glass, boxes (50 sq. ft.).	74,077	$440,738	53,165	371,315	632,841	3,449,660	898,769	6,080,782	562,856	3,854,721
Exported to:										
France	.....	.....	.....	.....	.....	.....	208,899	1,670,900	94	698
Canada	46,915	266,311	10,800	82,444	352,254	1,656,478	206,886	1,136,462	268,879	1,692,780
Mexico	1,892	14,756	3,040	27,210	16,728	108,618	20,619	152,295	28,414	234,381
Cuba	2,192	14,758	4,552	33,198	35,669	210,391	18,276	130,367	35,069	265,325
Argentina	.....	.....	13,951	76,925	46,088	333,617	86,661	607,491	32,502	223,769
Brazil	5,704	36,053	4,506	34,175	19,478	114,841	68,650	458,048	35,618	255,655
Chile	720	3,670	3,899	24,397	48,158	301,809	32,818	218,509	15,817	97,680
Uruguay	.....	.....	3,905	25,361	.....	.....	.....	.....	12,763	85,610
China	.....	.....	6	79	.....	.....	.....	.....	25,611	143,730
Japan	280	4,671	.....	.....	4,604	32,920	11,358	119,184	22,118	178,500
Australia	870	4,602	1,439	9,383	46,277	281,053	100,733	609,149	11,294	86,300
New Zealand	644	3,770	202	1,148	4,291	24,692	25,585	143,968	3,682	28,989
Other countries	14,860	92,147	6,865	56,995	50,294	385,241	118,275	834,409	70,995	530,995
Cut or engraved glassware	.....	26,626	.....	29,726	.....	126,242	.....	237,131	.....	381,279
Plate glass, unsilvered .....sq. ft.	224,046	114,122	302,784	263,564	5,313,455	2,763,849	7,014,998	4,057,917	3,878,832	2,638,040
All other	.....	810,421	.....	1,370,362	.....	4,916,117	.....	7,569,699	.....	11,173,114
Total glass, etc.....	.....	2,028,187	.....	2,811,459	.....	14,002,707	.....	22,879,839	.....	27,034,671

SHIPMENTS FROM THE UNITED STATES TO ALASKA.

Glass and glassware	.....	$5,880	.....	$8,304	.....	$54,194	.....	$59,582	.....	$89,378

SHIPMENTS FROM THE UNITED STATES TO HAWAII.

Glass and glassware	.....	$33,522	.....	$49,969	.....	$171,366	.....	$211,813	.....	$421,107

Current Prices of Glass-Making Materials

From quotations furnished by various manufacturers and dealers
New York, February 14, 1921

	Carlots	Less Carlots
Alumina hydrate .....lb.		.12 – .14
Arsenic trioxide (dense white, 99%) .....lb.	.09¼	.09¾
Barium carbonate .....ton	65.00	75.00
Bone ash .....lb.	.06¼	.06¾
Borax .....lb.	.06¾– .07½	.07 – .07½
Borax, fused, any mesh....lb.	.19	.20
Boric acid, fused.....lb.	.35	.35
Cadmium sulphide, red or orange .....lb.		1.60
Cadmium sulphide, yellow..lb.		1.80
Cobalt oxide .....tins, lb.		3.00
Cobalt oxide .....bbls.		3.10 –3.25
Copper oxide, red .....lb.		.50 – .55
Copper oxide, black.....lb.		.30 – .35
Feldspar, 90% .....ton	18.00	
Fluorspar .....ton	60.00	70.00
Kaolin .....ton	25.00	35.00
Kryolite .....lb.		.15
Lead oxide (red lead, Pb_3O_4) .....lb.	.09¼	.09¼
Litharge (PbO) .....lb.	.08¾	.08¾
Lime—		
Hydrated .....ton	45.00	
Burnt .....ton	17.00	
Manganese (85% MnO_2)...lb.	.04¼– .06	.04½– .06½
Nickelic oxide (NiO), black lb.		.35
Nickelous oxide (Ni_2O), green .....lb.		.38

Current Prices—(Continued)

	Carlots	Less Carlots
Potassium carbonate .....lb.	.09	.09½
Potassium nitrate .....lb.	.09¾	.10
Powdered blue, 98%.....lb.		3.00
Salt cake, for glassmakers.ton	28.00–30.00	
Selenium .....lb.		2.25
Soda ash, 58% dense, bulk..lb.	1.72½	1.85
Sodium nitrate .....lb.	.03¾	.07
Sodium selenite .....lb.		2.25
Sulphur (flowers) .....lb.	.03¼	.03½
Uranium oxide .....lb.		2.25
Zinc oxide (ZnO) .....lb.	.09½	.10

Stock Quotations

(Reported by Moore, Leonard & Lynch, Frick Building, Pittsburgh, Pa.)

Pittsburgh Stock Exchange, February 4.

Shares	High	Low	Last
137 Am. Window Glass Machine, common....	108	107	107
30 Am. Window Glass Machine, preferred...	84	84	84
115 Am. Window Glass, preferred.....	100	99	100
195 Pittsburgh Plate Glass.....	116	115	115
United States Glass, 47 offered			

Wheeling Stock Exchange, February 4.

Fostoria Glass Co.....	103	103	103
Hazel-Atlas Glass Co.....	155½	153	153
Imperial Glass Co.....	90	89	90
Central Glass Co.....	130	130	130

Toledo, February 9.

	Bid	Asked
Libbey Owens Sheet Glass, common.....	124	134
Libbey Owens Sheet Glass, preferred.....	95	100
Owens Bottle Machine, preferred.....	...	99